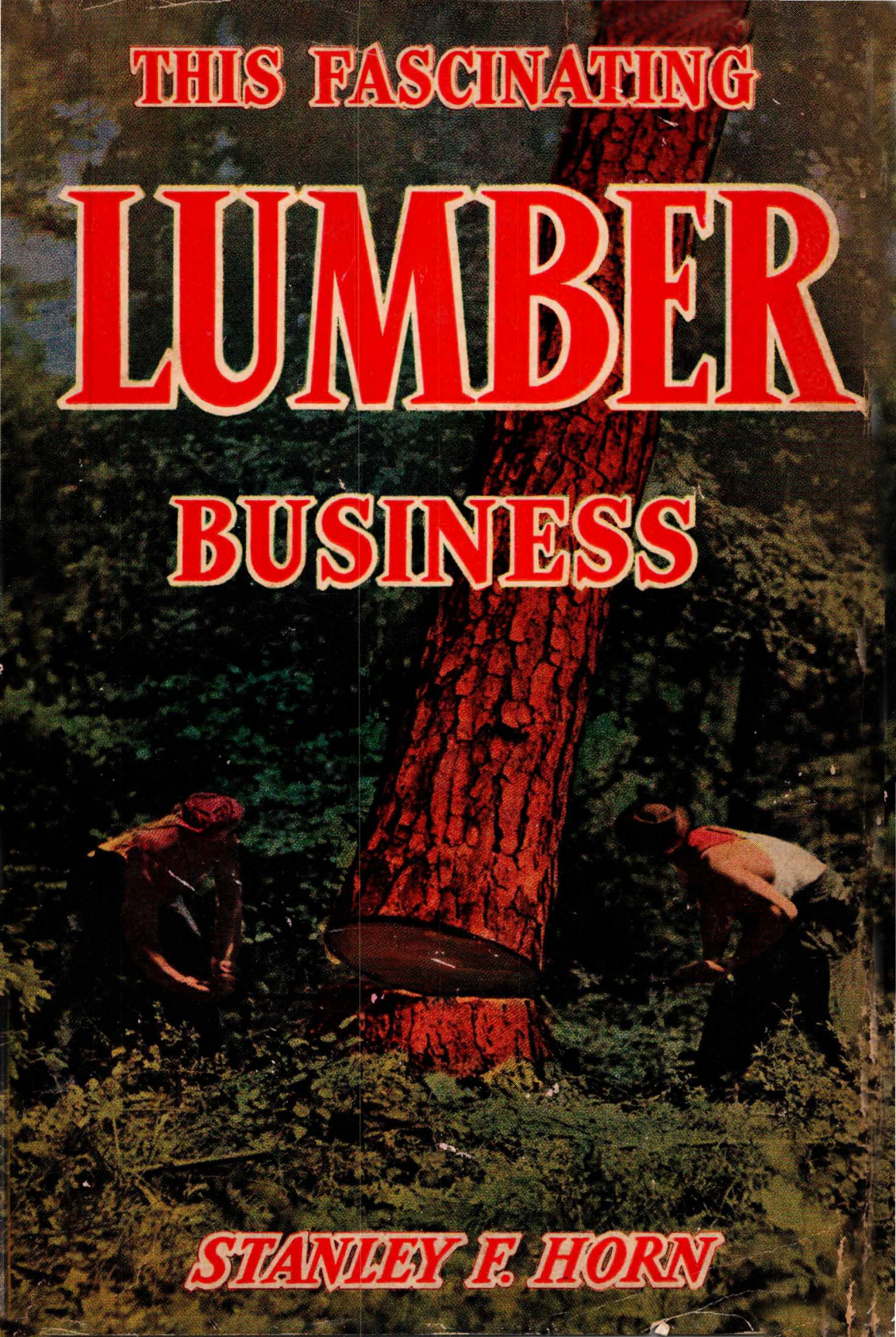
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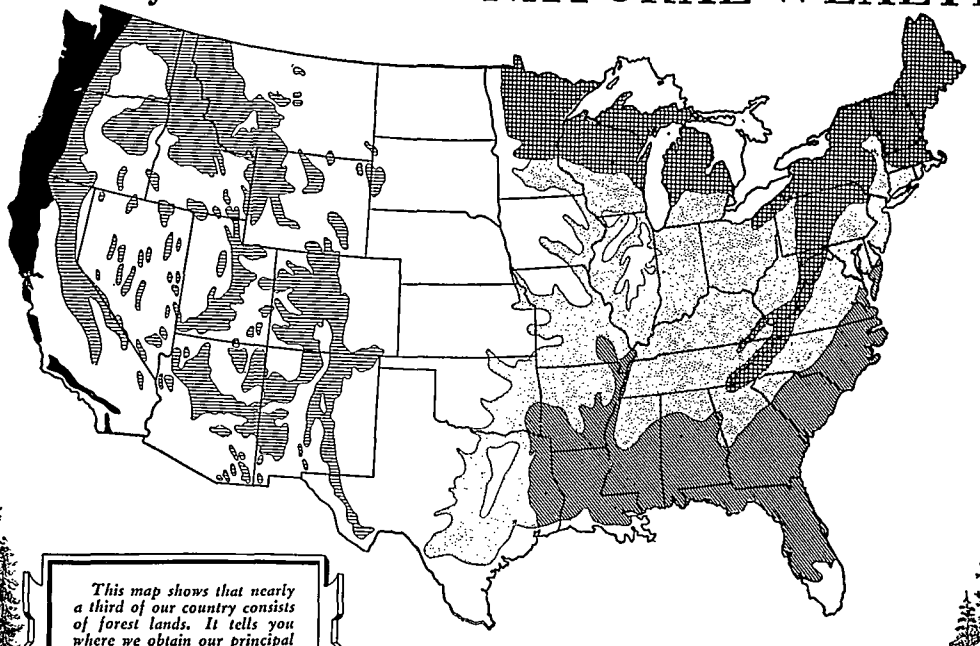
LUMBER

BUSINESS



STANLEY F. HORN

Areas of Renewable NATURAL WEALTH



This map shows that nearly a third of our country consists of forest lands. It tells you where we obtain our principal crops of trees and where the leading kinds grow.

This Fascinating Lumber Business

by

STANLEY F. HORN

AUTHOR OF

The Army of Tennessee

THE BOBBS-MERRILL COMPANY

PUBLISHERS

INDIANAPOLIS NEW YORK

DEDICATED TO

THE LUMBERMEN OF THE UNITED STATES

whose great service to the country has
never been properly recognized
or appreciated

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FOREWORD

In the first place, what is the lumber business? Many people think of any industry as "the lumber business" if it is based on wood as a raw material. Lumber, however, is only one of the many products derived from trees. The lumber business is only one of the family of forest-products industries—industries whose basic raw material is wood—but it is the biggest and most important member of the family. The members of this family, like all families, are closely related and are similar in some of their characteristics but also totally different in others. The family resemblance between a filmy bit of rayon lingerie and a two-by-four is negligible, but they have a common source—the tree. The sawmill and the plant producing the rayon pulp are both forest-products industries.

The forest-products industries family is a big one, the fifth largest in the United States. It employs 1,713,600, of whom 845,300 are engaged in lumbering. In all, an estimated 15,000,000 people depend on the forests of the United States for a living. The forest-products industries' total payroll, $1,111,464,77", ranks fourth in the nation, lumber's share being $746,557,000. These industries also rank fourth in value of product, $4,146,644,068; of which lumber provides $2,500,673,000. The forest-products family is not only a big family, but a wealthy one.

"Lumber" is the name applied to one very definite group of forest products. It is officially and authoritatively defined by the American Lumber Standards of the Department of Commerce as: "The product of the saw and planing mill not further manufactured than by sawing, resawing and passing lengthwise through a standard planing machine, crosscutting to length and working." There are many other interesting and useful things made from logs—veneers and crossties and barrel staves and hammer handles and scores of other things. All are valuable and important products—but they are not lumber. Hereafter when we speak of the lumber business it will be in reference to the business based on the "product of the saw and planing mill."

There are various divisions and subdivisions to this multiplex and far-flung lumber industry. To begin with, trees of course provide the basic raw material of the industry—and there are 1100 different kinds

of trees growing in the United States. Of that 1100 about 100 are of some commercial importance, and about 35 are commonly manufactured into lumber.

These 35 are almost evenly divided between two basically different kinds of wood—softwoods and hardwoods. An element of confusion is introduced here by the fact that relative hardness is not the differentiating characteristic in classifying the two; some softwoods, paradoxically, are harder than some hardwoods. In general, the softwoods are the coniferous or needle-bearing trees, like the pine, fir or hemlock; the hardwoods are the broad-leaved trees, such as the oak, maple or gum. Lumber from the softwoods is principally used in construction, while hardwood lumber is mostly used industrially.

These woods are handled by three sharply defined classes of lumbermen: manufacturers, wholesalers and retail dealers. Some combine the functions of two or perhaps all three of these classifications, but usually they are conducted as entirely separate lines of business. The sawmill operator is a manufacturer. The wholesaler is essentially a salesman. The retail dealer is a merchant. They all deal in the same commodity, but their functions and their points of view are different.

To say that a man is a lumberman or that he is in the lumber business, is, therefore, an indefinite statement. In fact, it would be hard to give a simple, inclusive definition of "the lumber business." There is not much cohesion or sense of unity in the industry. For one thing, lumber manufacturing is unique among natural-resource industries in that, despite its size in the aggregate, it is a group of small business enterprises in which the largest individual unit is a small part of the whole. Trees have a way of growing in remote and inaccessible places, so that logging operations and sawmills are frequently in isolated places. Moreover, the bulk of the country's lumber is produced in two widely separated sections—the West Coast and the South—whose operating conditions and regional problems are different and whose products are highly competitive. The retail lumber yards, about 25,000 of them, are scattered throughout the cities and towns of all the forty-eight states.

Attaining anything like a sense of industrial cohesion among these many thousands of scattered units is difficult to a point approaching impossibility. For that reason the lumber business in all its ramifications has never achieved a state of national unity such as has characterized the steel or automobile industries. The lumber business is

one of individualists. Its story is a stirring saga of enterprise, of vision and accomplishment and service. The user of lumber—the man who builds a home, or the industrialist who makes his product out of lumber or ships it in wooden boxes, or the householder who buys a new piece of furniture—is reaping the fruits of a long and complicated series of closely interrelated processes of manufacture and distribution which combine to make a fascinating story. This is an effort to present that story, briefly but in sufficient detail to give the lumber user some idea of what goes on in the process of making and delivering to him this useful and indispensable product.

It cannot be emphasized too strongly that the author is keenly aware of the impossibility of telling, within the space limitations of a single book, all there is to tell about the lumber business. Volumes have been written about individual phases of the business, and there are enough books about different aspects of lumbering to fill a small library. The best that can be hoped for in a book of this scope is to give enough of the significant highlights to present a fair picture of the whole industry. Undoubtedly much has been omitted which might have been included; but enough has been told, it is hoped, to give a proper perspective of one of the nation's greatest industries.

It is, regrettably, impossible to make detailed acknowledgment of the debt of gratitude owed to so many for assistance in writing this book. It has been made possible by an accumulation of information gathered in thirty years of contact with the lumber industry in all its aspects, embracing travel from coast to coast and border to border. To this accumulation contributions have been made by thousands of loggers, lumbermen and foresters. Essential statistical and technical data has been generously supplied by the United States Forest Service, the Forest Products Laboratory and the secretaries of the lumber trade associations, to all of whom an expression of appreciation is due, and is hereby accorded.

S. F. H.

Chapter I

THE BIRTH AND GROWTH OF THE LUMBER BUSINESS

IN TELLING any story the proper place to begin is the beginning. Usually such procedure does not present any particularly difficult problem, but in attempting to tell the story of the lumber business in the United States we are surprisingly confronted with a variety of opinions as to just when and where the industry was started on this continent. One thing may be set down right here as certain, however: the lumber business is the oldest business in America, the first form of trade engaged in by people living in what is now the United States. That fact cannot be successfully challenged.

Granting this precedence, there is still a difference of five or six centuries in the estimates of historians as to the date of the launching of the industry in the New World. Some students of lumber history trace its beginning back to the days of the Norseman, Eric the Red. They recall how Leif Ericson came to the shores of New England A.D. 1000 and took back a cargo of timber with him to the Viking colony in Greenland. Later, about 1110, Thorfinn Karlsefne—a Norse navigator, trader and businessman—sailed to Greenland and, hearing of Ericson's "Vinland," set out to relocate it, shrewdly figuring that trees would be found there. He did not reach New England but put in at "a place of strong tides," which Mr. Stefansson has identified as Labrador. Karlsefne stayed there three years, cutting down trees and shipping the timber to Greenland and Iceland, and later Norse visitors also operated in these New World forests. There are frequent references in the Norse sagas during the next few centuries to the importation of timber into Iceland from "Markland" (America), and in 1347 there was a record made of the shipwreck of one of the timber-laden vessels just before it reached its home port in Iceland.

For the benefit of any who might regard the Norse records as verging too much on the legendary, it is possible to skip down a few hundred years into the early days of the seventeenth century and find plenty of authentic written accounts of the early development of the

timber resources of our continent by the English-speaking colonists.

There is still some difference of opinion among the historians as to the date and place of the first sawmill's location. The weight of historical evidence, however, points to the Jamestown settlement in Virginia as the location, and the date probably 1608—or possibly 1620. The Jamestown settlement was a business enterprise on the part of the Virginia Company, and Captain John Smith, knowing of the Company's intense interest in the natural resources of the new country, in one of his earliest letters to the president of the Company in 1608 reported "the countrey most over growne with pynes." This wealth of "pynes" seems to have impressed the men back in England, for the records of the Company reveal that when the Second Supply was brought to the colony in 1608 by Captain Newport, there were also brought along eight "Poles and Dutchmen" for the purpose of erecting sawmills. It is not to be supposed that the hard-driving Smith, with his "no work no food" program, would have permitted these Polish and Dutch millwrights to remain idle, so it seems a safe assumption that Virginia had a sawmill in 1608. Certain it is that during that year Smith reported the work he had done in manufacturing "pitch and tarre and clapboard, whereof some small quantities we have sent you"; and when Captain Newport that year returned to England he carried with him "pitch, tarre, clapboard and waynscot" —America's first export shipment of manufactured goods. The Virginia Company's annals further recount that in 1620 "with great care and cost there were procured men skilful in sawing milles from Hambrough"; and the Virginia Colonial Records state that in 1621 some of the Dutchmen were sent "to build saw mills and seat them at ye falls"—the present site of Richmond.

The only apparent disputant of Virginia's precedence is the state of Maine. The earliest claim in that state seems to be for a mill supposed to have been built at York in 1623, but there is no authentic historical record of this, and it is probable that this activity at York was only a logging operation engaged in getting out mast timber. A tablet in the town of South Berwick states that a sawmill built there in 1634 at the foot of Asbenbendick Falls was the first in the state, and it is known that a ship from England (the *Pied Cowe*) brought a sawmill out to Maine at about that time. Incidentally, one of the earliest sawmills in New England was operated on the Saco River during the seventeenth century by John Alden, son of the bashful

John who undertook to do Myles Standish's courting for him and ended up betrothed to Priscilla Mullens.

Maine's first sawmill was probably not the first in the New World, but New England has one outstanding claim to pre-eminence in lumber history. Away back in 1605 Captain George Weymouth of the British Royal Navy nosed his vessel into one of the Maine rivers and took back with him some samples of white pine—an event commemorated today by the fact that in England white pine is still sometimes called "Weymouth pine."

Among the first authenticated commercial cargoes ever shipped in the export trade from this continent (probably the very first) was a shipload of eighty Virginia pine masts consigned from Jamestown in 1609 in "a ship of three-hundred tonne burthen called The Starre." This vessel was sent out from England for the specific purpose of obtaining these masts, scupper holes having been cut to permit their loading. And what masts they were! They were so long they had to have their ends sawed off on the Jamestown beach to get them into the ship's hold, and when *The Starre* arrived in England the shipbuilders were astounded at their size and quality. A few years later *The Anne* took a cargo of white pine clapboards to England from the Plymouth settlement in Massachusetts; ships were also leaving New Amsterdam loaded with timber for the Netherlands—and so the American export lumber business got its start.

From the middle of the seventeenth century the British Navy Board drew heavily on the forests of New England for white pine masts, the old forests of the New World supplying without difficulty sticks forty yards long and forty inches in diameter—far exceeding in size and in quality the masts then available from the diminishing forests on the shores of the Baltic Sea. In those days a ship's masts were generally the same number of yards in length as of inches in diameter—a big forty-yard mast measuring forty inches across at the butt end, and so on. As the size increased the price jumped up in leaps of geometrical ratio. A stick measuring thirty-five inches and yards, for instance, sold for £88, whereas a "thirty-six" cost £110, so the mast trade was a profitable and attractive one.

The British Navy at this time was wallowing through a dismal period in which its strength was crippled by inefficiency and corruption in high places. The negligence (or worse) of the Navy Board moved one wrathy naval official to write later: "The real timber prob-

lem of the Royal Navy was the trouble with the wooden heads which guided its policies, and England did not have to import that kind of timber." It did have to import its masts, however, and also much of its oak; and before long the forest resources of America—the live oak and longleaf pine of the southern coast, as well as the white pine of New England—were contributing largely to the production of the British men-of-war. The King's hated "broad arrow" was branded on the choice trees of the American colonies, reserving those trees for the Crown, thereby providing another cause for the colonists' irritation and adding another straw to the colonial camel's back. This trade with the New World necessarily languished during the Revolutionary War, but immediately after the war's conclusion the British Admiralty was again trafficking with the new United States and soon was once more importing the American shipbuilding woods so sorely needed.

Furthermore, the people of the new nation were now developing their forest resources for their own use, not only in the construction of ships but in the building of the houses and other things they needed to sustain life. Nobody thought of raising any question as to the adequacy of the timber supply. On the contrary, the early settlers' only problem with timber was how to get rid of it. They found trees growing everywhere, and trees then were not regarded so much as a valuable natural resource as an encumbrance on the ground which was needed for the cultivation of food crops. The land was gradually cleared of the encumbering forests as the settlements multiplied. Sawmills were set up and some of the trees were floated or hauled to the mills and converted into lumber; those not needed for lumber were frequently piled into great heaps and burned to get rid of them. Even after the land clearings there was still an abundance of timber in sight. It was obvious that the timber supply was far in excess of any dreamed-of needs of the people—"inexhaustible" was the word most commonly used in this connection in those early days—and there was no stinting the use of it.

From this beginning the lumber industry on our continent grew. It not only grew with the country; it helped the country to grow. Without a bounteous supply of timber settlement of the new land could not have been effected so speedily, easily and economically. It is no exaggeration to say that our vast forests constituted the one great, essential asset of the new republic without which its success

would have been doubtful. But the trees were here. Enterprising artisans set up their sawmills in every settlement. Lumber and timber and shingles were available for home-building in every community. The country grew; the lumber industry grew.

The story of the industry and the men who made it is a story which has all the thrilling qualities of a great drama. The lumberman has ever been a man of vision, a man of action and of daring. He has had times of prosperity, but he has also had periods of adversity, plenty of them; and through it all he has carried on, converting into usable material our most abundant natural resource. Since our nation was born in 1776 he has produced the prodigious total of 2,726,000 *million* board feet * of lumber, more than half of which has been cut since 1906. That is a lot of lumber. It is enough to build 58,000,000 urban homes, 13,000,000 farmhouses, 2,000,000 schools and libraries, 650;000 churches and 450,000 factories. If all that lumber were brought together in one pile it would make a stack that would cover a city block and rear itself more than 400 miles into the air. It would equal a solid block of wood more than a mile square. It would build a four-foot walk from here to the sun. In addition to that huge amount of sawed lumber, the forests of the United States have produced 6 billion cords of fuel wood, 150 million tons of pulp for paper, 450 million telephone and telegraph poles, 11 billion fence posts and 10 billion railroad ties—all essential factors in the development of the country.

Best of all, this tremendous production has been accomplished, making possible the building of this nation to its present state, without exhausting the timber supply or necessitating any general curtailment in its use because of scarcity. While this more than two *trillion* feet of lumber was being cut, the remaining trees have kept on growing, and during the next one hundred and fifty years another two trillion feet may be cut and still leave a supply for the future—of which more will be said later.

The development of lumber production in America during the earliest days was mostly along local lines. The manufactured material was largely consumed within a narrow radius of the point of manufacture, and was generally cut to order. There was, in fact, no real "lumber industry" in those days. There were merely a number of

* The "board foot" is the basic unit of measure in the lumber trade. It is a piece of wood of the nominal dimensions of one inch thick and one foot square.

individuals in scattered towns and communities who were serving their neighbors by providing them with a plentiful and economical building material. If the mill happened to be favorably located at a seaport or on a sufficiently large stream, some of its production might be floated down the river to a near-by town or even shipped by sailing vessels to a domestic or to a foreign market.

Mills were mostly small affairs, involving a limited investment and of equally limited capacity. For the first two or three decades of the nineteenth century they were universally water-driven and of the "sash-saw" type. The sash saw was an ingenious device with a single saw blade held rigidly in a vertical frame or sash which moved with an up-and-down motion. The log was forced against the saw by a primitive form of ratchet feed works, and slowly sliced into boards. This was but a mechanization of the old-style "pit sawing" in which the log was converted into boards by means of a long saw in the hands of two men, one on a platform above the log and one in a pit dug beneath it. The mechanized sash-saw mill was some improvement on pit sawing—but not much. Its capacity was strictly limited; its best output was about 500 feet of boards per day.

Daniel Webster's father had a sawmill in New Hampshire which was of this leisurely sash-saw type. The immortal Daniel—who unblushingly admitted his aversion to physical labor—stated that in his boyhood he liked nothing better than to be assigned the task of operating this mill. When he had put the saw into position and started the saw he then had sixteen minutes for rest or reading before the saw had worried its way through the length of the log and again required attention.

An amusing but possibly exaggerated industry legend has it that in operating one of these old sash mills the operator would start a cut soon after breakfast and then go out in the field and plow all morning. By noon that cut would be finished and he would set the log over for another cut and go home to dinner. After dinner he would resume his plowing and by nightfall the second cut would be completed. According to this story, by close attention to business a man could produce two boards a day on one of these mills. One reputedly veracious sawyer on an old-fashioned sash mill relates that it was his customary practice, after starting the mill, to sit down on the log and go to sleep. When the log finally had moved up far enough so that the saw scratched his back as it came down he then had plenty of time before

the saw came up to rouse himself and get off the log before another downstroke started.

Accepting these stories with the liberal saline seasoning they deserve, the fact remains that the sash saw left much to be desired in the way of speed and efficiency. It was not until the introduction of the circular saw, and later the band saw, that the business of making lumber assumed the aspects of a real industry.

Since the lumber industry grew up with the country it naturally and inevitably reached its first peaks of activity in the neighborhood of the most populous colonies along the Atlantic Coast. The state of Maine loomed large in the early development of the industry. It had a tremendous growth of big timber of good quality; loggers on the Penobscot claimed that the timber there would last till hell froze a foot thick! The trees were mainly white pine, always so highly prized —and they were convenient to the growing settlements of the North Atlantic seaboard. In scanning old statistics, one finds Maine among the leading states during all the years which saw the beginning of American lumber production.

In fact, from 1820 until as late as 1900, Maine, the "Pine Tree State," was looked upon by the general public as the typical lumber-producing state. Here it was that the lumber industry, as such, had its birth. Here was born and bred the race of lumbermen who later fanned out over the country and developed the richness of our forests. The very name of Maine became synonymous with the romance which surrounded the production of lumber through those early years, and the state figured prominently in lumber affairs for the better part of a century. Indeed, even today Maine produces a sizable volume of lumber every year; and the foresters tell us, surprisingly enough, that Maine's timber supply is greater than it was thirty or fifty years ago.

Even when the states to the west began to outrank Maine in the statistical tables as the decades rolled by, this change in position was not so much because her own production was lagging as because the other states were producing more lumber as the country's population increased and spread. There was, in fact, almost a constant increase in the value of Maine's lumber production throughout the whole nineteenth century—$13,489,000 in 1900 as compared with $7,167,000 in 1870 and $1,808,000 in 1840. The peak of her cut was not reached until 1909 when the state's mills produced 1,111,565,000 feet, and the total production reached a billion feet again as late as 1915.

Entirely aside from all statistics and economics, however, Maine has always been essentially a lumber state in the public estimation. People read lurid tales of her lumberjacks and their swaggering, brawling ways, of her snowbound lumber camps in the north woods, of the log jams on her swirling rivers as the spring floods boiled down to the sea. When they thought of lumbering they thought of Maine—and operations in Maine were indeed typical of what northern lumbering was like in the beginning.

The production of lumber was then a picturesque and adventurous affair, involving daredevil pluck, luck, brute strength and a rough-and-tumble grapple with nature in the raw under the most rigorous, difficult and dangerous conditions. Timber was plentiful and cheap—William Bingham, one of Maine's pioneer lumbermen, bought a block of more than two million acres of white pine timber for twelve and one-half cents per acre, and in smaller quantities it sold for as low as six cents. But timber in the fastness of the Maine woods was not lumber on the seaboard market. The trees had to be cut down and the logs transported to the sawmills; and this was a man-sized job. It was a man-sized job that bred a race of he-men, the like of whom are to be found no more on the face of the earth. One early visitor to the Maine woods described the loggers as "a young and powerfully built race of men, generally unmarried, and though rude in their manner and intemperate, quite intelligent." Another thought they were given to "prodigality, irreligion, immoderate drinking and other ruinous habits." Stewart Holbrook characterizes them briefly as "a crew of veritable hellions—rough, tough, lusty and thirsty."

Logging was at first strictly a wintertime operation. When the ground was covered deeply with snow the subfreezing temperature converted the skid roads into smooth sheets of ice along which the ox teams hauled prodigious loads of logs on sleds and skids to the established landings on the banks of the rivers. Men spent the winter in the woods, braving blizzards and zero weather, living in primitive camps where diet and other necessities of life were reduced to the simplest terms. Beans and salt pork, bread and molasses, were washed down with a strong and bitter brew of tea which the growling loggers said would raise blisters on a marble-topped table. This constituted the loggers' menu, day in and day out—fare which might horrify a modern vitamin-conscious dietitian but which seemed to be just what the Maine loggers needed to make them thrive and grow strong under

their back-breaking job. Their "camp" was a crude log bunkhouse, air-conditioned by the Northern breezes which swept through its chinks, with straw-filled bunks in two or three tiers around the inside walls. A rude bench, generally fashioned from half-logs on legs, ran around the room along the lower bunks. On this "deacon's seat" the men sat in the evenings and on Sundays, swapping lies, smoking and chewing tobacco—the only social and recreational interludes in the dawn-to-dusk job of getting out the logs.

By early spring the loggers' winter work was done. The logs were bunched at the landings and preparations were made for "driving" them to the downstream booms and mills. Preparations for the drive consisted principally in waiting for the customary spring freshets on the rivers, tides which would gather in the logs and sweep them tumultuously down to their destination. As Thoreau put it in his *Maine Woods*: "All winter long the logger goes on piling up the trees which he has trimmed and hauled in some dry ravine at the head of a stream, and then in the spring he stands on the bank and whistles for Rain and Thaw, ready to wring perspiration out of his shirt to swell the tide." When Rain and Thaw did finally answer the loggers' whistle and the floods came and carried away the winter's cut of logs, then ensued those thrilling, nerve-racking log drives of song and story —especially song. Lumberjacks from the Atlantic to the Pacific have whiled away many a lonesome evening singing doleful ballads of the drives' thrills, hazards and tragedies. Typical is the old favorite entitled "The Jam on Garry's Rock." This classic of the lumber camps began with the following invitation:

Come all ye brave shanty boys, wherever you may be;
I would have you pay attention and listen unto me.
I'll sing you of a shanty boy, so noble, true and brave
Who broke the jam on Garry's Rock and filled a watery grave.

Then it rambled on through interminable verses to an inevitably tragic climax:

They buried him most decently ('twas in the month of May).
Come one and all, ye shanty boys, and for a comrade pray.
Engraven on a hemlock tree which on the beach did grow
Was the name and date of this sad fate of the foreman,
Jack Monroe.

Jack Monroe and his shanty boys had their counterpart on many a flood-swollen river in those days, and the Maine log drives constitute a dramatic and spectacular chapter in the early history of the lumber business. During those turbulent weeks of spring the rivers were choked with a churning, boiling mass of logs. The Androscoggin, the Allagash, the Mattawamkeag, the Passamaquoddy, the Penobscot, the Piscataqua, the Michias, the Kennebec—all of them bore through the brawling rapids their contribution of raw material for the sawmills clustered about the waterfalls on their lower reaches.

A log drive was a difficult enough matter under the most favorable conditions. The log drivers in their calked boots, equipped with pike poles and peaveys, ran nimbly along the groaning logs, shoving them along if they strayed or lagged in an eddy, or prying them loose if they became temporarily obstructed. But sometimes there was an obstruction which defied the driver's art. A log became stuck between the rocks; other logs piled up behind it; soon the channel was choked with a mountainous pile of straining, creaking logs: this was the much-dreaded, often fatal "jam."

To have witnessed an old-time log jam on one of the surging Maine rivers is a privilege given to few, but the next best thing to seeing one is to read about it as Stewart Holbrook tells in his *Holy Old Mackinaw* of one he saw in his boyhood days on the Connecticut River:

We rushed down to the river. There we saw it with our own eyes —the river piled high with logs. Yes, sir, a jam! Stretching for half a mile down-river was the huge bulk of logs, crossed like so many jackstraws; long spruces up-ended, their dripping bodies standing straight out of the mass. We could hear creaking and a mild groaning as the water ground the logs more firmly together.

The river was backing up fast, and 'way down below we could see small figures on the logs and the banks, working feverishly. Now and again, it seemed to us watching, the great mass of logs would give a long, deep sigh.

Below the jam the river was a mere trickle. They'd have to work fast, we knew, or soon the water would be backing up into the village. And they were working. We watched breathlessly as they danced like puppets to and fro across the barrier, looking for the key log, the king log, the single log that must be moved before the jam could be broken. There was a clanking of peaveys, a cursing to high heaven, and many shouted orders, as the men tore first at this log, then at that. Over all

was the ominous feeling of impending danger. You couldn't shake it off, so you talked in whispers.

There was a cry of warning. Slim Pete Hurd, one of our rivermen heroes, had "got holt on" the king log. We could see him twist it from its grudging fellows and roll it down. Then there came a quaking and a shifting of the huge mass as the drivers ran for shore, balancing themselves with their peaveys on the struggling logs. Not all of them made the shore, for the water and the pent-up logs would not wait, even for the rivermen. The jam "hauled" with a rush of tossing logs, and some of the men had to ride her out, Death riding everywhere among them.

Through the thunder of the mad logs we heard a cry: "Pete's gone!" And, looking downstream where the crest of the flood was rolling, we saw a slim body thrown high in the air, to fall again—into the white water and among those grinding logs. . . .

On the way back to the village we did not talk much, for there was a lump in every boy's throat. When we got to the bridge the logs were moving fast and freely, but we didn't stop to watch them. Near the bend of the river, where the jam had been, a few logs floated idly. The river grumbled no more. The village was still as death. The drive had gone down.*

Death stalked the riverbanks as the drives went down in the spring. Pete Hurd's fate was not an unusual one for a log driver, although it was said admiringly of those daring rivermen: "You could throw a bar of soap into the river and they would ride the bubbles to shore." But, regardless of accidents and death, the drive went on. The river's surging current bore the logs on downstream to the waiting mills.

Just before arriving at the millsites on the lower river, the logs were caught in a "boom"—a gathering place where their forward progress was stopped—and through a "sorting gap" they were separated into groups according to ownership, as established by the brands. The booms were constructed of heavy timbers or logs, connected by strong steel chains, strung between wooden piers built up in the river. The size of the booms depended on the volume of business transacted at them, the one on the Penobscot being two miles long. The owners of the booms exacted a toll for their services, and the logs after being separated were rafted on to the various mills for manufacture into lumber.

* From *Holy Old Mackinaw* by Stewart Holbrook. By permission of the Macmillan Company, publishers.

The towns of the lower rivers abounded with sawmills during the early decades of the nineteenth century. On the Penobscot just north of Bangor, for instance, there were 154 single saws and 15 gang saws in 1850. The mills were all water-driven by means of undershot wheels, and did not operate during the winter months. The lumber they produced was shipped by coastwise sailing vessels to Boston, New York or other near-by markets, or in the export trade, largely with the West Indies, as well as with England, South America and even far-off Australia.

Maine was the cradle of the American lumber industry, but as the country expanded and the settlements moved back from the coast line, the industry correspondingly spread into the interior, a development which we are able to follow through the statistics of the United States Census—fragmentary and inconclusive at first, but fairly informative and revealing in succeeding decades since 1850.

The enumeration of 1810, first to include anything like an industrial census, showed 150 sawmills in Massachusetts (which then included Maine), 28 in Rhode Island, 113 in Maryland, 112 in Virginia, 65 in South Carolina, 43 in Louisiana, 14 in Indiana, and 2,016 in Pennsylvania. There are no reports at all from the states of New York, New Hampshire, Connecticut and North Carolina—which probably reflects the inadequacy of the census facilities rather than any actual dearth of mills in those states. The surprising (and almost unbelievable) disparity between Pennsylvania and the other states may be accounted for by the enumeration of the number of saws instead of the number of mills—or it may be due to the fact that Philadelphia had been the national capital. Certainly there is nothing to support the belief that Pennsylvania at that date had ten times as many mills as Massachusetts. For all practical purposes the 1810 census may be disregarded.

The census of 1840 was the first which gave any apparently reliable figures of the status of lumber manufacturing in the various states, and this shows a total production of about a billion and a half feet. New York was in the lead, with 6,356 mills, the product of which was valued at nearly $4,000,000. Pennsylvania was next in order with 5,389 mills, cutting lumber valued at $1,150,000. The first spurt in production in Pennsylvania had come in 1838. In that year the first mill was built at Williamsport, which later became a big lumber center with 50 sawmills. Following Pennsylvania in the 1840 census came

Ohio with 2,883 mills, Virginia with 1,987, Maine with 1,381 and Massachusetts with 1,252. Of the newer states, Indiana led the field with 1,248 sawmills, followed by Tennessee with 977. Alabama had 524, Georgia 677, Mississippi 309 and Louisiana 139. Of the later giants in lumber production, Michigan then had 491 mills and Wisconsin 124; Oregon and Washington were not on the map.

In 1850 the country's total lumber production was over five billion feet. The leading state was again New York, followed by Pennsylvania, Maine and Ohio. Production in Pennsylvania had been spurred by the building of the famous "Susquehanna Boom" at Williamsport. This boom, promoted by James H. Perkins, who had come to Pennsylvania from New Hampshire in 1844, stimulated the production of logs on the upper West Branch and encouraged the building of more sawmills at Williamsport.

In 1860 the production total had climbed to more than eight billion feet. Pennsylvania had the most mills, followed by New York, Ohio, Indiana, Michigan, Maine and Virginia, in that order. Here we find for the first time the name of Michigan, a state which was to play a stellar part in the lumber world for the next half-century or more. The first effort at the development of Michigan's wealth of white pine had been in 1832, when a mill was built at Saginaw—destined to become one of the outstanding centers of all lumber history. This mill, however, at that time did little more than a local business, and the financial panic of 1837 snuffed out a budding development. It was not until about 1850 that lumber production in the Lake States took a new start, and then it grew rapidly. The choice white pine of the Maine woods was being exhausted. Maine still had plenty of other timber—spruce and hemlock—but the pioneer white piners scorned these trees as worthless weeds and looked beyond the New England horizon for more white pine. The pineries of New York and Pennsylvania were already being exploited, so the Maine men looked still farther westward and found what they were looking for: more "inexhaustible" forests of the incomparable white pine on the shores of the Great Lakes.

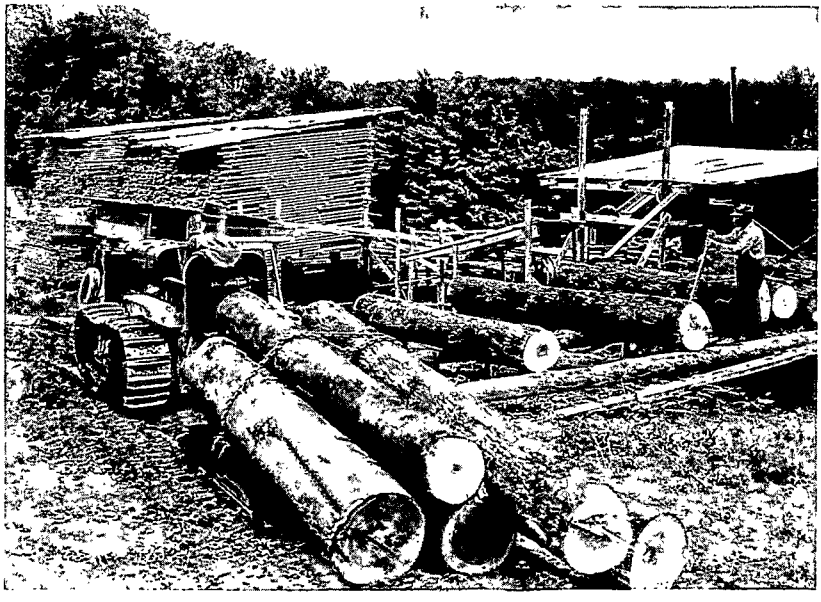
In 1870 the total lumber production was just short of 13 billion feet. As to number of mills, Pennsylvania remained in the lead, with New York, Ohio, Indiana, Michigan, Maine, Missouri, New Hampshire, Wisconsin and Tennessee following. From the standpoint of total production in board feet Michigan was now in first place, trailed

by Pennsylvania, New York, Wisconsin, Indiana and Maine. During this 1860-1870 decade Michigan made a tremendous stride forward, not merely in the number of mills but also in value of product, which amounted to nearly $32,000,000 in 1870—far ahead of any other state and not even approached by any except Pennsylvania and New York.

In the census of 1880 Michigan almost doubled its 1870 production figures, the total output of the Michigan mills (4,172,572,000 feet, valued at $52,000,000) being more than twice that of Pennsylvania, then in second place. Pennsylvania was trailed by Wisconsin and New York, these being the only four states cutting more than a billion feet that year. Pennsylvania still led ten other states from the standpoint of the number of mills, their order being: Pennsylvania, New York, Ohio, Indiana, Michigan, Virginia, Missouri, Maine, North Carolina, Tennessee and Wisconsin. By this time the Lake States, with 35 percent of the total, had seized the position of leadership in production from the Northeast. The Northeast had produced most of the lumber cut in the United States up until 1870; but from then on the production of this region, although it actually increased from 1,400,879,000 feet in 1870 to 2,667,800,000 feet in 1909, gradually dwindled in relative importance.

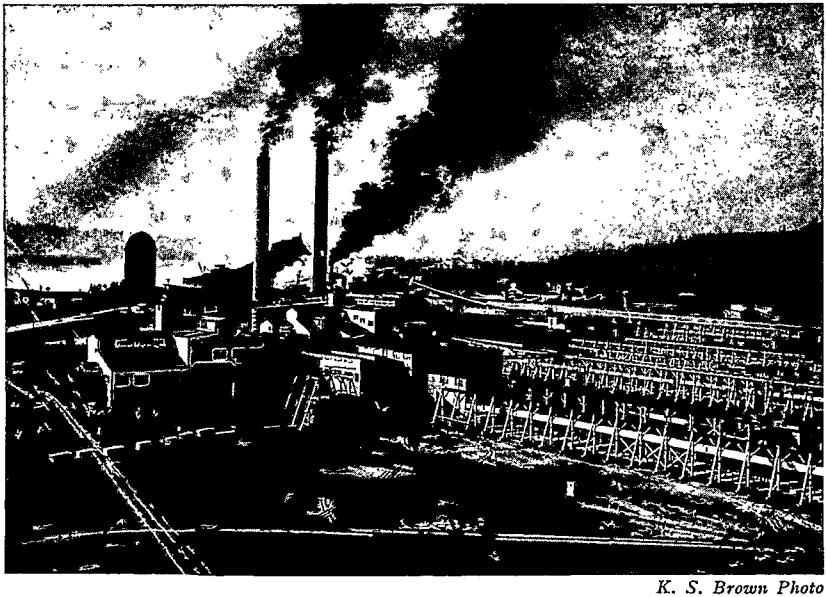
In 1890 Michigan was the leading state in all departments of the census figures, with 2,214 mills in operation cutting 4,245,177,000 feet of lumber, valued at more than $83,000,000—the peak of Michigan's ascendancy. In number of mills she was followed by Pennsylvania, New York, Indiana, Ohio, Wisconsin, Maine, Missouri, Tennessee and Vermont. In volume of production Pennsylvania, Wisconsin and New York still trailed Michigan in that order. The swing of production to the Lake States was emphasized by the fact that in this year Wisconsin was in second place just behind Michigan, value of product ($61,000,000) being more than twice as great as Pennsylvania's in third place.

Ten years later the census figures still reflected the importance of the Lake States in lumber production, but also showed impressively the gains in the South and West. In fact, the South had risen to the top rank of regions in 1899, with 32 percent of the total production, the Lake States standing second with 25 percent. Individually, however, the states of the latter region were the leaders. Wisconsin had stepped into first place in production (3,389,166,000 feet) and also in value of product with its $57,634,000. She was followed by



PORTABLE "PECKERWOOD" MILL

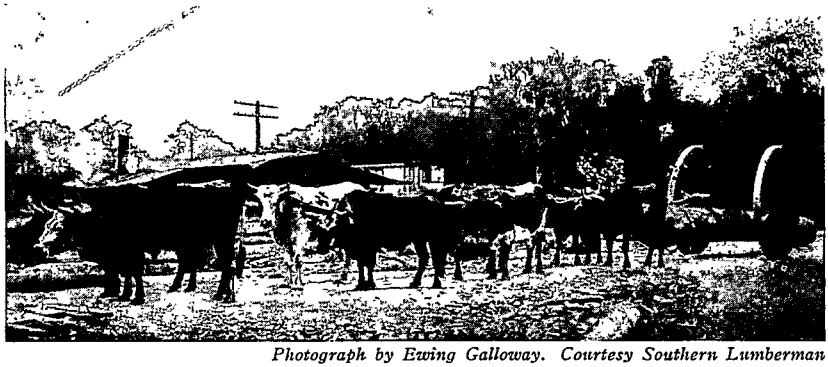
Portable "peckerwood" mill of the piney woods—sawmilling in its simplest and most primitive form.



K. S. Brown Photo

WEYERHAEUSER MILL

The Weyerhaeuser sawmill at Longview, Washington—the biggest sawmill in the world. Capacity, about 1,500,000 feet per day.



Photograph by Ewing Galloway. Courtesy Southern Lumberman

"HIGH-WHEEL" LOGGING—YESTERDAY

"High-wheel" logging, with the log suspended from the axle, as practiced in the old days, with oxen for the motive power.



CRAWLER-TREAD LOGGING ARCH USED FOR HANDLING BIG TIMBER

Michigan with 3,018,338,000 valued at $54,000,000 and Minnesota with 2,342,338,000 feet worth $43,000,000. Pennsylvania, Arkansas and Washington were next in order in volume of production. Of the twelve states having an annual production of more than a billion feet at this time, seven were in the South. In total number of mills the first ten states in 1900 were Pennsylvania, North Carolina, Indiana, Ohio, New York, Michigan, Tennessee, Virginia, Georgia and Kentucky.

The census of 1910 showed in a graphic manner the spectacular swing of lumber production to the undeveloped forests of the South and the West. The nation's lumber production had reached its all-time peak in 1909 with a total of 44,509,761,000 feet. Of this total eleven states classified by the Forest Service as "Southern" (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Texas and Virginia) yielded 44.8 percent. The Western states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming) produced 18.4 percent. Arranged in the rank of production, the first ten states in 1910 were: Washington, Louisiana, Oregon, Mississippi, Wisconsin, Texas, Arkansas, North Carolina, Michigan and Virginia. The old stand-by state of Pennsylvania was trailing such upstarts as Alabama, Minnesota and West Virginia, and Maine was still farther down the list, preceded by Georgia, Tennessee, Florida and California. New York, once up among the leaders, was now lost in the limbo of "Others" at the bottom of the statistical table.

The growing dominance of the South and the West was emphasized again in the census figures for 1920. Production was slightly less than 34 billion feet, of which the South produced 42.6 percent and the West 35.7 percent. The South had now held first rank in regional production for twenty years. Output in the Northeastern states, which produced 54.8 percent of the total in 1850, had shrunk to 6.5 percent; the Lake states, from their peak of 34.6 percent in 1890, were down to 7.1 percent in 1920. Washington once more headed the list of states in the production figures (5,525,000,000 feet), followed by Oregon, Louisiana, Mississippi, California, Texas, Arkansas, Alabama, Wisconsin and Idaho. Louisiana, which in 1920 fell back to third place, had ranked second in production every year since 1906—except in 1914, when she ranked first. The increasing importance of the small portable mill, the so-called "peckerwood" mill, in the South

was indicated by the fact that North Carolina led all the states in the number of mills with 1,215, but was twelfth in the list from the standpoint of total production.

The 1930 census figures began to reflect the reduced production of the depression years, the total being only 26 billion feet. The all-time low was reached in 1932, when the total production slumped to 10,151,232,000 feet. Washington was again in first place in 1930, the other states making up the first ten being Oregon, Louisiana, California, Mississippi, Alabama, Texas, Florida, Arkansas and Idaho. The three West Coast states' production increased to a total of more than ten billion feet, about 40 percent of the total production that year. The mills in the South produced 11 billion feet, or about 42 percent of the 1930 total. From the standpoint of the number of mills, the Southern states were again in the statistical forefront, North Carolina leading with 1,610, followed by Alabama, Georgia, Virginia, Tennessee, Mississippi, South Carolina, Arkansas and Kentucky.

During the three decades following the peak of 1909 the total production of lumber in the United States was approximately one trillion feet. Of this total the South produced about 43 percent, maintaining a fairly steady volume of annual production while the other states east of the Mississippi were gradually declining. During this thirty-year period the South and West together furnished 79 percent of the nation's entire lumber cut. From 1909 through 1925 the South held the place of leadership, with an average annual share of 46 percent of the total cut. In 1926 the West took the lead with 42.9 percent of the total, the South following closely with 42.2 percent.

In 1940 the three West Coast states (Oregon, Washington and California) had moved into the first three places in the lumber production list, with a total production of 11,700,000,000 feet—40 percent of the total production. The other states making up the first ten were Alabama, Georgia, Mississippi, Arkansas, North Carolina, Texas and Louisiana—all Southern states. The South in 1940 produced 13,515,000,000 feet of lumber, or 46.5 percent of the total. The total production in the West was 13,231,000,000 feet—45.5 percent of the total. The dominating position of the West and South is indicated by the fact that between them they accounted for 92 percent of total production, the remaining 8 percent being divided among all other states of the Union. Further significance in these figures is to be seen in the continued high ranking of the South as a lumber-produc-

ing region, long after the time when it was supposed to have reached the point of timber exhaustion. The Southern timber supply had been reproducing itself more rapidly than was suspected. The changing nature of the lumber-manufacturing industry in the South, however, is indicated by the large number of individual producing units in this section. The 1947 census showed only eight states with more than 2,000 mills each, and seven of them were in the South—Alabama, 2,605; Georgia, 2,867; Kentucky, 2,168; Missouri, 2,672; North Carolina, 4,588; Tennessee, 2,567; Virginia, 3,101. These figures show clearly the shift in Southern lumber production to smaller mills and more of them.

Statistics indicate that lumber production in the South has now leveled off at something approaching a fixed volume of production which may be maintained from the renewed and continuing timber supply. In the West lumber manufacturers are still operating largely in original-growth timber. The large supply of this old-growth timber, supplemented by the later harvest from young timber now coming on, seems also to insure a steadily maintained production from this section. Apparently the South and the West together will be able to produce a very large part of all the lumber the country is likely to need.

Chapter II

THE TIMBER SUPPLY

THE facts about the nation's future supply of timber run counter to the popular impression on this subject. Ask the mythical man in the street, or average man, about the status of the timber supply and the chances are about nine out of ten that his answer will be on the pessimistic side. Most likely he will shake his head sadly and murmur something about an impending timber famine. He will be wrong about this, but there is a reason for his wrongness.

The American public has an erroneous impression of the supply of timber in this country. Alarmists have dingdonged the "timber-famine" theme until most people think that the end of our timber supply is definitely and dangerously close at hand. Many of them think honestly that the good timber (and the good lumber) is almost exhausted and that unless we cut down on the use of lumber there won't be enough to supply our own needs, much less the needs of future generations. Every time an old house is torn down there is somebody to shake his head in woe and say: "You can't get lumber like that any more." But the truth is that just as good lumber is being manufactured today as ever. The trees growing today are just as good as those that grew a hundred years ago, and the sawmills' manufacturing facilities are better.

For many years recurring predictions of "timber famine" have been made at more or less regular intervals by well-intentioned prophets. For centuries, in fact, this has been a peculiarly attractive subject. Somebody was always expressing fear that the trees would soon all be gone. In the sparsely forested and densely inhabited countries of Europe the fear was not unfounded, but our earliest settlers seem to have transplanted their fears along with their other mores, and the "timber-famine" cry was raised early on this heavily wooded continent.

As long ago as 1819 a visiting naturalist from France, F. André Michaux, spoke of the "alarming destruction of trees for building" describing it as "an evil which is increasing and which will continue

to increase with the increase of population." Complaints of the scarcity of timber, he said, were every year becoming more serious in America and he moaned that "even now inferior wood is frequently substituted for the white oak." M. Michaux was so concerned over the deplorable devastation of the American timber supply that in his will he bequeathed $14,000 to the American Philosophical Society to be used in providing instruction in forestry. Another early alarmist was J. D. Brown, who in 1832 wrote in his *Sylva Americana* that, despite the apparent plenitude of forests, "the best building materials are nearly exhausted." "Where," he asked challengingly, "shall we procure supplies of timber fifty years hence for the continuance of our Navy?"

This train of thought continued year after year, and similar views were expressed from time to time by forestry writers. In 1873 the definite prediction was made that the timber supply on this continent would be exhausted in ten years, and the only voice raised in protest was that of an unconquerably hopeful editor in Bay City, Michigan, who stoutly insisted that the timber would last twenty years instead of ten.

The contagious pessimism had by 1875 infected Carl Schurz, Secretary of the Interior, and he declared in his annual report that within twenty years the timber would be so far gone as to "fall considerably short of our home necessities." The Department of Agriculture was equally doleful in its outlook on the timber supply. In its 1880 report on forestry a solemn warning was issued that nothing could be more fallacious than the theory that the supply was inexhaustible, with the dark prediction that "the near future" would assuredly prove the fallacy of such ill-founded optimism. Again in 1884 the Department, referring to the current belief that there was an abundance of timber in the South, declared that even in the South "there is not such a forest wealth as has been supposed to exist." In fact, the report continued, "There is hardly any portion of the country in which it has not been difficult to find timber of the best quality."

One of the more optimistic of the early pessimists was Henry Gannett, who in an article in the October 1900 issue of the *Forum* estimated that the stand would last "about fifty years." But eight years later Gifford Pinchot, one of the first and most vocal of the conservationist-alarmists, was proclaiming that "We have in store timber enough for only twenty or thirty years." "A timber famine is

one of the inevitable events of our near future," Mr. Pinchot declared. "We have all but reached the end of our forests." In that same year, 1908, James Wilson, Secretary of Agriculture, re-echoing the Pinchot view, stated that in less than thirty years all the remaining virgin timber would be cut. "We are clearly over the verge of a timber famine," said Secretary Wilson.

Mr. Pinchot was steadfastly consistent in his opinions and as late as 1922, in his foreword to Zon and Sparhawk's *Forest Resources of the World*, he wrote: "Our own forest resources are being depleted. Our high-grade hardwoods are almost exhausted. . . . The last great bodies of softwoods—those on the Pacific Coast—will soon be gone. Lumbermen of this and other countries are thinking seriously of getting timber from the great but little-known forests of Asiatic Russia."

Incidentally, if Mr. Pinchot needed any official backing up for his prophecies (which he did not) he could have found it in the report of the Senate Select Committee which in 1920 expressed alarm at the prevailing situation and voiced the prediction that the Southern pine timber would all be gone in fifteen or twenty years.

But not all the prophecies of timber exhaustion came from misguided, misinformed conservationists. In 1924 the Southern Pine Association, an organization of lumber manufacturers, engaged F. V. Dunham, a research engineer, to make a survey of the South and find out the facts about the remaining supply of timber. Mr. Dunham's report was of such a dismal nature that the association never had the heart to publicize it. It was his opinion that the supply was good for only about twenty or twenty-five years; and, specifically referring to the small mills of Georgia, he predicted that they would nearly all be out of business in six or eight years. This was bad, but not quite so bad as the view of the Secretary of Agriculture, who in his 1924 report stated that "97 percent of the sawmills operating in the South will have used their reserve supply of timber within ten years," and said further that "many well-informed lumbermen place the duration of important commercial cut of lumber at no longer than ten years."

But, somehow or other, the timber famine recurringly failed to keep its appointment. When 1897 arrived the lumber manufacturers were enjoying one of their eras of greatest activity, with an abundance of timber, and nobody seemed to remember that that was the year when, according to Carl Schurz, the supply of timber would fall

short of our home necessities. In 1908 the date set for the exhausting of the timber had been 1928—but when 1928 came around there were still plenty of trees in sight. In 1922 Mr. Pinchot had begun to hedge to the extent of saying that the timber would "soon be gone" instead of specifying the exact number of years it would last—but that "soon" has stretched out thirty years, and today the timber is far from being all gone. We have also passed safely through the danger zone of 1935-1940 as dated by the Senate Report of 1920. The "six or eight years" lease on life mentioned by Mr. Dunham in 1924 has expired, and the mills in Georgia are now cutting more lumber than they did then. The year 1934 has passed into history—and that was the year named by the Secretary of Agriculture in 1924 as the date of the end of the "important commercial cut of lumber." Mr. Brown's century-old apprehensions as to the supply of timber for our Navy has proved groundless. More than a hundred years after his warning in 1832, our forests were able to supply all the lumber and timbers needed for the building of the ships used in waging our war against the Axis powers; and M. Michaux, who was so worried about the supply of white-oak ship timbers in 1819, would have been pleased to see our sawmills turning out large quantities of oak for the mine sweepers, torpedo boats and chasers in World War II.

The "inevitable" timber famine proved to be not quite so inevitable as had been predicted. The forests seemed to be a sort of silvical miraculous pitcher. Timber areas which were supposed to be exhausted continued to supply logs for sawmills which should have cut out and moved on long ago. States in which timber was theoretically exhausted continued to rank high in the annual statistics of lumber production. The timber-famine prophets scratched their heads and pondered.

What all of these early pessimists failed to remember, however, was that while they were "viewing with alarm," the timber supply was being augmented by the simple process of tree growth. New seedling trees were springing up by the millions wherever the control of forest fires made it possible for the tree seeds to germinate; every standing tree was putting on a new layer of growth every year, thus increasing its diameter and its content in terms of board feet of merchantable wood.

The effect of this was especially noticeable in the South, with its fertile soil, its abundant rainfall and its long growing season. Take

Georgia, for example. All the so-called "virgin" or "original-growth" timber was cut off by the big mills long ago, but when the building boom after World War I created an increased demand for lumber, little "peckerwood" mills sprang up in the "second-growth" timber of Georgia and soon the state was producing more than a billion feet of lumber a year. Mr. Dunham in his 1924 survey regarded all this hectic activity as a flash in the pan, and was confident that the available timber would not sustain it for more than six or eight years. But in 1940 the state of Georgia produced 1,612,000,000 feet of lumber; and it has produced in the past ten years from 1,510,000,000 feet (in 1945) to 1,982,000,000 feet (in 1946)—more than it produced in its heyday.

The state of Alabama provides further convincing statistics. The early demise of the lumber industry in Alabama was forecast years ago; but today it is cutting more lumber than any other Southern state. Annual growth of its forests is three times as great as the total production of all sawmills in the state, and the growth is almost equal to the total removal of timber for all reasons: saw logs, pulpwood, poles, piling, fuel, and loss from fires and insects. The six New England states provide another example. In 1924 they produced 1,059 million feet of lumber. In 1947 the same states produced 1,140 million feet, which was equal to the average annual production from 1801 to 1935.

One thing which helped to mislead the timber-famine prognosticators was the fact that practically all early estimates of how much timber there was in the country and how long it would last were the wildest sort of guesses, based on nothing more substantial than the estimators' personal opinions. Large figures were flung about recklessly, but wide disparity in the guesses showed how little was actually known about the existing timber supply. Take, for example, estimates of the yellow pine stumpage in the Southern states. In 1880 the United States Census Bureau estimated the total stand of yellow pine at 237 billion board feet, but twenty years later placed it at 300 billion feet. In 1903 R. A. Long, a prominent and well-informed lumberman, investigated the matter and came up with an estimate of 187 billion. Two years later a lumber trade paper made another guess, its figure being 300 billion. The United States Department of Commerce and Labor made a study of the subject in 1911 and announced that there was a total of 384 billion feet of Southern pine stumpage—

twice as much as the Long estimate of 1903 and 70 percent more than the official United States Census figures of thirty-one years before—to say nothing of the billions of feet of stumpage which had been removed in the meantime.

The wide disparity between these guesses, official and unofficial, emphasized the flimsy basis for many early utterances on the subject of forest conservation. How is it possible to justify the charge that an individual is a spendthrift unless you know how much money he has and how much his annual income is? If a man has $50,000 in currency in a safe-deposit box, with no additional income, and is spending $5,000 a year, then we know that his money will all be gone in ten years. But it is not the mere fact that he is spending $5,000 a year that makes him a spendthrift. If he has, say, $200,000 and it is not idle but is bringing him in an income of three percent, then the annual expenditure of $5,000 stamps him as a man of thrift, safely living within his means. His original capital and his income are the governing factors as to his solvency, not his spending.

So it was for many years with the question of forests and their use. We had annual figures as to the total production of lumber, the expenditure of our forest wealth; but we had no figures as to the total amount of timber on hand, our capital—and, most important of all, we had no information whatever as to the rate of growth. It was in recognition of this fact that in 1932 the United States Forest Service launched the official Federal Forest Survey in the principal timber-growing areas of the country. The Survey involved a timber-cruising job of staggering proportions, and its findings have been kept up to date with re-appraisals conducted since World War II. From the reports covering these surveys we are able to derive some interesting conclusions, based on facts and not on surmise.

The report on the "Lower South" is particularly informative. This producing region's output of lumber had been expected to fall away to unimportant levels long before this, as its old-growth timber was used up; but it had surprised the lumber world by maintaining its volume of production, utilizing the second-growth timber. All lumbermen were eager to see what facts the Survey revealed about this section.

The total area embraced in the "Lower South" is 213 million acres, of which 122 million are classified as productive forest land. The entire region south of the Mason-Dixon line, the section geo-

graphically known as "the South," includes 380 million acres, of which about 238 million acres are forested. The forest figures for the entire South, therefore, may be roughly computed as correspondingly greater than the Survey statistics here discussed, which apply to the group of states it has officially designated the "Lower South."

One of the most striking facts brought out by the Forest Survey is the extent to which the lands of the South are now covered by growing timber. Although the South is generally considered to be an agrarian region, almost 60 percent of its entire land area is still in forest growth and less than 30 percent of it is in cultivation. Furthermore, the Survey indicates that the area under forest is expanding rather than contracting; and Survey officials say it is reasonable to believe that at least 60 percent of the South's land surface will be devoted to the growing of timber for generations to come.

Even more surprising and significant were the Survey's findings as to the total volume of merchantable timber. In this Lower South area, the Survey reveals, there is still standing the tremendous total of 323 billion board feet of saw timber—trees thirteen inches and up in diameter in hardwoods and nine inches and up in pine. This does not include the more than a billion cords* of trees between five and nine inches in diameter, nor any of the trees under five inches—and it is these little trees, down to the tiniest seedling, which constitute the potential growing supply of timber for tomorrow. For the entire South figures indicate a total stand of saw timber amounting to almost 400 billion feet. This, it should be emphasized, does not include the potential timber supply of tomorrow, the young trees inventoried as cordwood, nor the uninventoried billions of trees ranging in size from seedlings up to those five inches in diameter.

The revelation of such a large stand of merchantable timber in the South was surprising and comforting news to those who had been misled by the timber-famine predictions. The South was one of the areas supposed to have been cut out years ago. Many people had been led to picture its onetime forest lands as barren wastes; and the news that the trees were still growing there came as a surprise. But the most encouraging and eye-opening facts brought out

* A "cord" is a cubic measure for cut wood. In the United States it is a pile of wood occupying a space eight feet by four feet by four feet. The actual amount of wood in a cord depends on the diameter of the individual pieces and the consequent spaces between them. Roughly, it takes two cords to make a thousand board feet.

by the Survey were those relating to the rate at which these forests are reproducing themselves and the ratio of growth to use. Forests, it must always be remembered, are the only self-renewing natural resource. The forests are not static. Trees keep on growing every year.

To achieve a full understanding of the exact meaning and significance of the Forest Survey's findings as to the relation of timber growth and use, it is necessary to examine and understand the terminology used by the Forest Service. They use the word "drain" to cover the total volume of timber removed from the land for all purposes and by all means. It includes losses from fire, insects and disease (about 15 percent of the total), as well as use of trees for fuel, fence posts, pulpwood, crossties, veneer logs, mine timbers, cooperage stock, shingles, poles, piling—everything for which wood is used. Lumber accounts for only 58 percent of the total saw-timber drain. The figures as to increment (growth) are sometimes confusing, since they are expressed in terms of both board feet and cubic feet, and it takes twelve board feet of lumber to make a cubic foot.

Taking all these factors into consideration, the Survey figures show that in the South the total annual increment has been greater than the total annual drain—that the trees were growing faster than they were being removed. In the saw-timber class the growth was about 11 percent less than the drain; but it must be recalled that this "growth" was the saw-timber growth and did not take into account the smaller trees graduating each year into the saw-timber size. Incidentally, it might be mentioned that the annual saw-timber cut for lumber in the region was less than 16 billion board feet as compared with a saw-timber growth of more than 20 billion feet and a total growth of all trees of 6½ billion *cubic* feet.

The situation prevailing in the South is discussed in detail because it furnishes a clean-cut example of the reason why a timber famine is not imminent or probable. The South's lumber production would have faded away to the vanishing point by now if the timber-famine prophets' calculations had been right, but the experience of the South shows clearly that the mere fact of the exhaustion of the old-growth timber does not necessarily mean the end of the timber supply. The trees grow, and as the young trees reach maturity they produce a new crop of timber. There has been an almost complete timber-crop cycle in the South. In the West the cycle is just begin-

ning. The Western sawmills are still well supplied with old-growth timber and are only beginning to fall back on second-growth for a log supply. They have not yet had to face the transition period which the South is successfully bridging; but experience in the West shows that the removal of the mature old-growth timber speeds the growth of the younger trees, and there seems every reason to believe that, when it becomes necessary, the Western lumber-manufacturing industry can shift to second-growth as its major source of log supply, as the South has already done.

The current annual drain in the Douglas fir region is estimated by the Forest Service at 12 billion feet. The present growth rate there is low because a large percentage of the area is now occupied by old virgin stands which are at a standstill in growth. The regional rate of growth will increase as more virgin areas are converted into young stands, and it is calculated that it will ultimately reach 10 billion feet annually—or possibly 15 billion feet under ideal conditions. Substantially the same situation exists in the Western pine region—a current excess of drain over increment—but with a possibility of greatly increased growth as the nongrowing mature forests are cut and converted to growing conditions. The South is not the only region in which an approximate balance between forest growth and use can be attained. As a matter of fact, the growth of saw timber in the Northeast right now is substantially greater than the drain, and in the Lake States the growth and drain of all timber is approximately in balance.

The official Forest Service figures show that the total stand of timber in the United States today is 470 billion *cubic* feet. Sawmills and other forest industries use about 12 billion cubic feet per year, and the present annual increase by growth is placed at more than 13 billion feet. Destruction by fire, insects and disease removes an additional billion and a half feet a year, but this is potentially offset by the prospective increase in growth and by steady improvement in fire protection. The replacement of nongrowing mature timber by thrifty, growing stock, coupled with improved growing conditions resulting from the increasing adoption of better logging methods, gives promise of a steady rise in the rate of timber growth. Loss from forest fires should be steadily decreased in the future as the public becomes aroused to the importance of fire protection.

The Forest Service statistics reveal that there are now in the

United States 624 million acres of forest land, constituting more than one-third of the total land area of the country. It is estimated that originally trees covered about 822 million acres of our present United States, which means that we still have about three-quarters as much forest land as we had in 1630—although we have used twice as much timber as existed at that time. Extremists among the advocates of conservation use these figures to indicate that we have "destroyed" the timber on 192 million acres of land. Another way of looking at it is to consider that these 192 million acres of cleared land are now agricultural lands, or are occupied by cities, towns or farms. The timber removed has been used in building houses and other things needed by the people, and "destruction" seems rather a violent word to use in describing such utilization.

Of the 624 million acres of remaining forested land, there are about 168 million acres classified as "noncommercial," because their timber growth is not available, accessible or valuable. This leaves about 461 million acres of timber land designated as "commercial." Nearly half of this, more than 205 million acres, contains saw timber. Young trees which have not yet attained commercial size occupy another 95 million acres. The remaining land is covered with forests in various stages of reproduction, from poor to good.

Geographically, the commercial forest area is distributed as follows: the South, 44 percent; the West, 26 percent; Northeast, 13 percent; Lake States, 11 percent; and Central States, 6 percent. Quantitatively, the distribution of the saw timber is: West, 69 percent; South, 22 percent; Northeast, 5 percent; Lake States, 3 percent; Central States, 1 percent.

Foresters, in discussing the country's timber resources, consider the forests as lying in five broadly defined regions: the Northern, the Central, the Southern, the Western and the West Coast areas. These regions, it should be observed, are largely determined by botanical rather than geographical limitations. The Northern forest, for example, extends in a belt along the Canadian border from Maine to Minnesota, with a long finger extending down the Appalachian range. It embraces 117,782,000 acres of forest land, much of it cut over and later burned over, but still sustaining a growth of 62 billion board feet of softwood saw timber and 80 billion feet of hardwoods.

The Central forest region is mostly filled with hardwood timber, largely in small tracts intermingled with farm land. It supports a

little less than 30 million acres of forest land, with about 14 billion feet of hardwood timber and 370 million feet of softwoods.

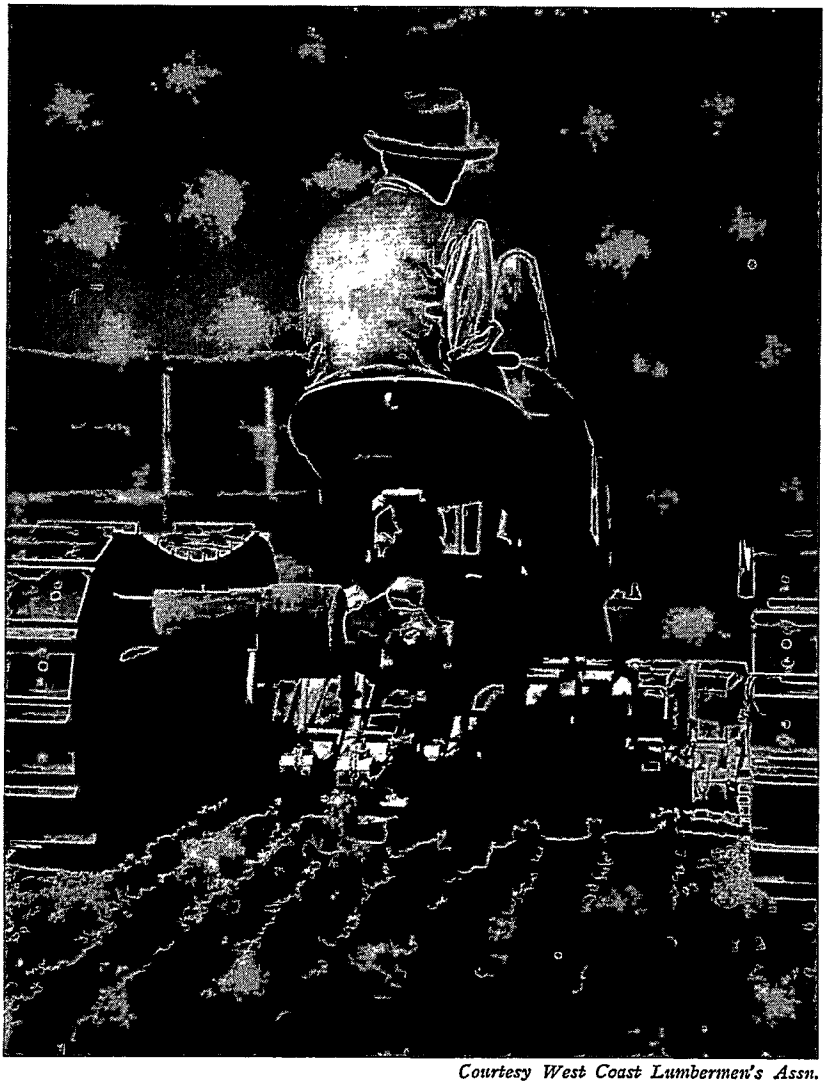
The foresters' Southern forest grows on what is geographically considered the coastal plain of the South Atlantic and Gulf coasts. It carries about one-fourth of all the country's saw timber, including about 215 billion board feet of softwoods and 172 billion board feet of hardwoods.

The Western forest embraces the trees growing in the eleven Western states, east of the Cascade Mountains and the California Coast Range. The timber is almost entirely softwood, and covers about 202 million acres of forest land, 90 million acres of which are classified as commercial timber. The softwood stand amounts to about 600 billion board feet, with a scattered 211 million feet of hardwoods.

The West Coast forest is on the western slopes of the Cascades and the California Coast Range, lying along the Pacific Coast of Washington, Oregon and California. This is the region of the biggest trees and the heaviest forest growth in the country. It is relatively small in area, about 46 million acres, but it supports more than 655 billion board feet of saw timber, most of it original growth. In fact, nearly one-half of the total volume of the nation's commercial timber stand is original growth, a forest bank account from which there have been no withdrawals. The rest of the commercial forest is second growth, some of it already ripe for the harvest and some of it growing stock.

The total supply of timber in the United States is 470 billion cubic feet, which includes 316 billion cubic feet of saw timber and 153 billion feet in cordwood trees. The supply of saw timber is about 1,601 billion board feet, about 60 percent of which is old growth. This saw timber is backed up by 2,455 million cords of wood in trees from five inches in diameter up to saw-timber size and 1,850 million cords of smaller trees.

It will be observed that about 40 percent of our available supply of saw timber is second growth. Some of the misconceptions regarding the timber supply have grown out of a tendency to ignore or to belittle the value and importance of this second-growth stock. During the early days of our timber development there was a general inclination to regard the so-called original growth or virgin timber as possessing some mysteriously inherent quality of superiority. This timber, to



Courtesy West Coast Lumbermen's Assn.

MECHANICAL DEVICE WEEDS BETWEEN ROWS
AT FOREST INDUSTRIES TREE NURSERY

Savings over hand methods are obtained using a combination weeding and cultivating device developed at the Forest Industries Tree Nursery, Nisqually, Washington. Owned and operated by the West Coast Lumbermen's Association, the nursery produces 8,000,000 seedlings annually for the reforestation of burns and other nonstocked areas on Tree Farms in the Douglas Fir region.



TYPICAL REDWOOD FOREST, WITH EVERY STAGE OF GROWTH, FROM A TINY SEEDLING TO A THOUSAND-YEAR-OLD VETERAN

be sure, was "original growth" in the sense that it was the timber standing on the ground when the early settlers first saw it. On the other hand, it was indubitably "second growth" as compared with the trees which had grown up and matured and died in the immediately preceding generation of forest growth; that generation was second growth as compared with the trees which grew before it, and so on back to the days of the creation of the world. A tree which started to grow fifty or seventy-five or a hundred years ago is growing in just the same manner as a tree which started growing two hundred or five hundred years ago. It is putting on successive layers of growth every year, just as trees have done since the beginning of time, and there is no basis for believing that a layer of growth put on in 1950 is in any way inferior to a layer put on in 1843 or 1776 or 1492.

One reason for the lack of appreciation of the value of the so-called second-growth timber among our early settlers and our early lumbermen was the fact that in the northern part of the United States where the lumber industry had its first development the growth of the trees was relatively slow and the potential value of the new growth was not so apparent. Lumbermen were openly skeptical about forestry. They had their money invested in timber, and the only way they could see to liquidate their investment was to cut down the trees and convert them into marketable materials. Cut-out-and-get-out was the blunt but expressive phrase describing the average lumber manufacturer's policy. It was a policy frankly devoid of vision or constructive concern for the future, a policy encouraged and aggravated by a system of high taxes and other factors which frequently made quick liquidation imperative.

Some thirty or thirty-five years ago, however, there slowly developed among a few lumbermen a suspicion that there were some flaws in a blind policy of cutting down all the merchantable trees in sight and then moving on. First it dawned on some of them that it was unprofitable to try to make lumber out of small trees, and so they began to operate on the basis of taking out only the larger trees for saw logs and leaving the young ones behind. This was not with any conscious idea of conservation, but solely because, from the cold-blooded dollars-and-cents standpoint, they had found that they could not make any money by cutting the small trees. In following this system of "high grading" they were unconsciously practicing a sort of primitive, elementary forestry; but it was not with any sense of obligation to

posterity or any hope of future reward. High grading simply seemed to be the most immediately profitable thing to do. The fact that in leaving a few seed trees standing they were unwittingly insuring a new crop of young trees was entirely fortuitous and unpremeditated.

The center of lumber production was then in the South; but it was generally accepted as a fact that the timber supply of that section was dwindling so rapidly that the life of the Southern lumber industry would soon be ended. This did not arouse any particular anxiety on the part of the sawmill operators, however. They were accustomed to a migratory existence; there was still a boundless supply of untouched timber on the Pacific Coast; and some of the big Southern mills were already cutting out and moving west. As the years slipped along there was pretty general agreement that the timber in the South was nearly all gone and that a great industry which had contributed much to the wealth and prosperity of this section would soon disappear. This fatalistic view was almost universally accepted. A few thoughtful lumbermen were thinking about forestry, but they were in a very small minority.

Then, shortly after World War I, something happened that started people—especially timberland owners—to thinking. Several Southern states which were supposed to have cut out all their timber years ago began to show up in the lumber-census statistics with figures indicating greatly increased production. Everybody knew in a vague sort of way that a part of it was coming from those new, small mills which had sprung up all around, referred to contemptuously as "peckerwood" or "coffeepot" mills; but where were they getting their log supply? How could these supposedly cut-out states possibly produce so much lumber?

The question seemed unanswerable, but in fact the answer was so plain that it had been overlooked. Young trees had been growing right along through the years since big mills had exhausted the then available supply of timber and moved on. When the increased post-war demand for lumber made sawmilling again attractive, new mills popped up in this once despised second-growth timber and began to produce lumber from trees which had grown up to saw-timber size while nobody was looking.

Then it began to dawn on foresters and lumbermen alike that in their consideration of problems involved in the question of the future timber supply they had missed the one big outstanding fact that trees

grow. Everybody, of course, knows it. The foresters knew it; the lumbermen knew it. But the lumbermen had generally dismissed it with the conclusion that tree growth was too slow to have any practical or commercial significance. Now, however, as they saw the lumber cut from new crops of trees moving successfully into competition with the lumber cut from the old-growth trees, they began to wonder if they might not have to readjust their business philosophy. Maybe under favorable conditions, trees would grow fast enough to make it profitable to grow them commercially.

Quickened by the eye-opening findings of the Forest Survey, the lumber industry now experienced a radical change in its point of view. It began to see that with a little change in its operating methods the manufacture of lumber and other forest products might be kept indefinitely at the current rate of production. The forests need not be regarded as a mine, to be exhausted and abandoned. More and more lumbermen began to talk forestry. They hired trained foresters to look over their timberlands and make recommendations for maintaining them.

The budding new interest in forestry in the lumber industry was crystallized by the advent of the NRA and the Blue Eagle in 1933. The Lumber Code then drawn up and adopted by the industry contained a section, Article X, which constituted a declaration of forestry principles and a compulsory code of approved forest practice. When the NRA was outlawed by the Supreme Court in 1935 the lumber industry voluntarily assumed the duty of carrying on with their forest-practice code, and this has been a recognized principle of the industry since then.

The lumber industry's attitude toward forestry then and since then was expressed by Wilson Compton, at that time secretary-manager of the National Lumber Manufacturers Association, at a forest-conservation conference in 1937:

> We want conservation and sustained production of forest resources and the perpetuation of the sources of livelihood of our industry.
>
> We want to arrive at a constructive solution and so far as practicable we want to arrive at it by the voluntary act of intelligent and well-disposed forest owners in co-operation with an intelligent and well-disposed government.
>
> We want to do our part and we want the public to do its part.
>
> The forest industries have their hopes and their eyes, not on the past but on the present and the future; and they express the hope that

the public agencies will join them accordingly in the planning and establishment of permanent productive forest industry in this country.

Summarizing the findings of the survey conducted by the United States Forest Service, it is seen that the present stand of saw timber in the United States amounts to 1,601 *billion* board feet, and that each year new growth adds 35 billion feet to the supply. During the past 350 years twice as much wood has been removed from America's forests as was growing here when John Smith landed at Jamestown in 1607, about one-third of which was used for man's needs and comforts; the balance destroyed by fire, insects and disease. Perhaps the most significant of all the figures developed by the Forest Survey are those relating to the increase in the *rate* of growth of saw timber: in 1918 the total growth was 9,672 feet; in 1944 the growth was 35,301 million feet—3½ times the 1918 rate of growth.

During World War II there was a heavy use of our forest resources, as we supplied the wartime needs of ourselves and our allies. In 1941 our total stocks of lumber in the United States were about 18 billion feet; in 1945 they were less than five billion feet. In other words, during the war period we used up 13 billion board feet of our national lumber inventory, in addition to the production of the mills during that period. Since V-J Day lumber has been provided for building 5,573,900 new non-farm housing units as well as for repairing or remodeling 4,000,000 other homes, and at the same time stocks have been built back up to 13.5 billion board feet. Despite this tremendous utilization of our timber wealth, however, there is still an ample supply of timber—if it is properly protected and used. The Forest Survey shows that our forests are growing at an annual rate of 13.4 billion *cubic* feet, with a total annual drain of 13.7 billion *cubic* feet. The survey also showed that the growth rate of saw timber at the time of the survey had tripled in 30 years and that the growth of all timber had more than doubled. We should continue to use our timber judiciously and protect it from fire, disease and insect damage —but we are still far from a timber famine.

Chapter III

TIMBER IS A CROP

IT IS generally recognized that fire is the chief enemy of the forests. Most of the horrible examples of forest "devastation" are cutover areas which have had their natural regrowth destroyed by successive burnings. One prominent forestry expert has said that fire control is 75 percent of the forestry problem. Losses from this cause have reached totals of staggering proportions. During the five-year period from 1936 to 1940 the average number of forest fires was more than 210,000 a year, and valuable timber covering a total area almost as large as the state of New York was destroyed. In 1949 the total number of fires was 193,774. In some single years fire has burned over an area as large as Massachusetts and destroyed property worth $90,000,000.

But it is hard to measure the damage done by forest fires merely in terms of the mature timber destroyed. A forest fire not only destroys the big trees, or damages them so as to reduce their value. It wipes out the growth of thrifty young saplings, it destroys the current crop of seedlings, it burns the humus from the ground and ruins the land's productiveness. Even an apparently harmless grass fire or brush fire, though it does no harm to the mature timber (except the thin-barked species), is death to the crop of young trees, the merchantable timber of tomorrow.

During recent years, as timberland owners have become increasingly aware of the possibilities in growing timber, there has been a corresponding increase in the expenditure of money in forest-fire prevention and control. Private timber owners spend millions of dollars each year to control fire. The Federal and state governments spend millions more. In all, some 20 to 30 million dollars cover the annual cost of fighting the forest-fire menace.

A significant and effective manifestation of the timber owners' activities in the way of forest-fire prevention is the "Keep Green" movement, which originated in the state of Washington and is now operating in 29 states. This functions in each state as an educational activity, enlisting the support and assistance of all interested persons:

foresters, educators, women's clubs, civic clubs, Boy Scouts—everybody interested in keeping fire out of the woods. It usually operates through state forestry departments, but the necessary funds are provided largely by direct contributions from timber owners. The one and only purpose is to keep fire out of the woods, to keep the landscape green, and this purpose is gaining supporters year by year.

The Western lumbermen learned early the necessity of guarding their forest property from critical fire hazard. They quickly found that co-operative protection of large forest areas is both far more effective and far more economical than if each landowner tries to work independently. From these lessons in the tough school of experience evolved fifty years of co-operative work. It has led the industry to the adoption of compulsory fire protection on all its lands under state law, to state fire codes constantly strengthened by new provisions as occasion and research required them to reduce the hazard or aid in control. Logging camps are now equipped with fire-fighting tools and pumps; snags (dead trees) are cut down and removed systematically; slashings (the limbs and tops left from logging) are carefully burned in controlled fires; closed seasons are established when no fire may be lighted in the woods. All this has grown out of co-operative attack upon the region's greatest problem—forest fire.

During World War II the West Coast fire hazard was intensified. The only enemy bomb to fall on the continental United States was a Japanese incendiary dropped in the forests of the Northwest during the early days of the war. The bomb was discovered and extinguished before it could do any damage, but that wasn't the Japs' fault. And a fire started through carelessness or accident is just as helpful to an enemy as one that originates in a bomb from the air or a saboteur's torch.

Forest fire-fighting methods vary with the locality and the nature of the fire, but the basis of all such protective systems is some method of quickly discovering the fire in its first stages and getting to it with extinguishing equipment before it assumes uncontrollable proportions. Most forested states now have systems of tall lookout towers, manned constantly during the dry season, with telephone or radio equipment for getting the fire-fighting equipment into action when a blaze is first discovered.

One of the most startling and spectacular innovations in forest-fire protection is the use of so-called "smoke jumpers" by the United

States Forest Service in attacking fires in the National Forests. These smoke jumpers are the paratroopers of the fire-fighting army. They are carried by airplane to the scene of the fire and there dropped out of the sky in a direct aerial attack on the enemy fire. Aside from his parachute, a smoke jumper wears a two-piece padded suit, a football helmet, a steel wire mask, ankle braces and a steel-ribbed leather corset. He carries in his pocket a coil of rope (for getting down out of trees) and a lightweight two-way radio set. His fire-fighting tools and supply pack are dropped to him by parachute after he lands. Helicopters are also being used increasingly for observation and "spotting."

Ordinary forest fire-fighting practice involves the use of a light tank truck (equipped with hose, extinguishers, portable pumps, axes, saws, rakes and shovels) which goes as close as possible to the scene of the fire and gets on the job at the earliest possible moment.

The financial participation of state, Federal and private agencies in fire-control work varies in different states and regions; but an increasingly effective job of forest-fire protection is being done by the co-operative efforts of these agencies under the Clarke-McNary Act, which authorizes Federal funds for this purpose. In 1949 the total expenditures for forest-fire protection in the United States were $27,875,460, of which the states supplied $17,200,919, the Federal government $8,572,593, and private agencies $2,101,948.

Although forest-fire protection work is still sadly inadequate, the results from what has been done have been encouraging. Statistics of the United States Forest Service for 1949 show that out of 651 million acres of forest land needing fire protection, 569 million acres, or 87 percent, were under some form of it during that year. Indicating the great effectiveness of protective work, the Forest Service statistics show that of 15,395,740 acres burned over during 1949, 2,635,622, or 17 percent, were on the protected area and 12,760,118, or 83 percent, were on the unprotected area. There is also enlightenment in the Forest Service's statistics as to causes of forest fires, these figures showing that of the total of 88,233 fires investigated during 1949 the origins were as follows: incendiary, 26,726; smokers, 17,442; debris burning, 16,465; lightning, 8,235; miscellaneous, 9,929; campers, 4,163; railroads, 3,805; lumbering, 1,468.

Experience shows that some of the most destructive fires have come from the most insignificant causes. A lighted match tossed aside on a dry roadside, the live coals of a campfire not properly

doused, can send roaring through the woods a blaze that will leave a tragic path of ashes and blackened destruction in its wake. It is impossible to be too careful.

Few laymen would think it likely that a forest fire could start from the heat generated by pulling one log across another on a hot, dry day, but that was exactly what started one of the most destructive forest fires in all history. This was the famous Tillamook Burn of 1932 which devastated 260,000 acres of Oregon's finest timberland, killing 12 billion feet of timber, and throwing a county into bankruptcy. It was a tragedy of major proportions, and it came within five minutes of being prevented. In fact, it would never have happened if a weary messenger had not stopped to drink a cup of coffee. Oregon has a law forbidding logging operations when the humidity is as low as 30. The West Coast Lumbermen's Association makes it a part of its business to watch the hygrometer and notify the loggers to stop work when that dangerous degree of dryness is reached. On this occasion a messenger had been sent to notify the Tillamook loggers, but on the way he rested fifteen minutes to get that cup of coffee. When he reached the camp he met the men running out of the woods to get fire-fighting help. The fire had started just five minutes before. Loggers now have telephones to be used in notifying them of humidity conditions.

Incidentally, the Tillamook disaster is a splendid example of how loggers can rescue victory from defeat. Much of the timber on the burned-over area was a total loss. But some could be saved. With characteristic speed and enterprise the owners organized a gigantic salvaging operation which is just drawing to a successful close.

At the time of the original fire in 1933 it was estimated that 12 billion board feet of mature timber was fire-killed. Through 1950 more than eight billion feet of the fire-killed timber had been salvaged and converted into lumber, plywood, pulp and other useful forest products. Currently there are from 90 to 100 operators logging daily in the Tillamook Burn (when fire weather conditions permit), and their aggregate production is about three million feet daily. It now looks as though salvage will continue for at least another ten years before all the reclaimable values will have been recaptured. An interesting development is that, according to the predictions of those qualified to make such estimates, the total volume of salvaged timber will be greater than the original estimate of the total volume killed

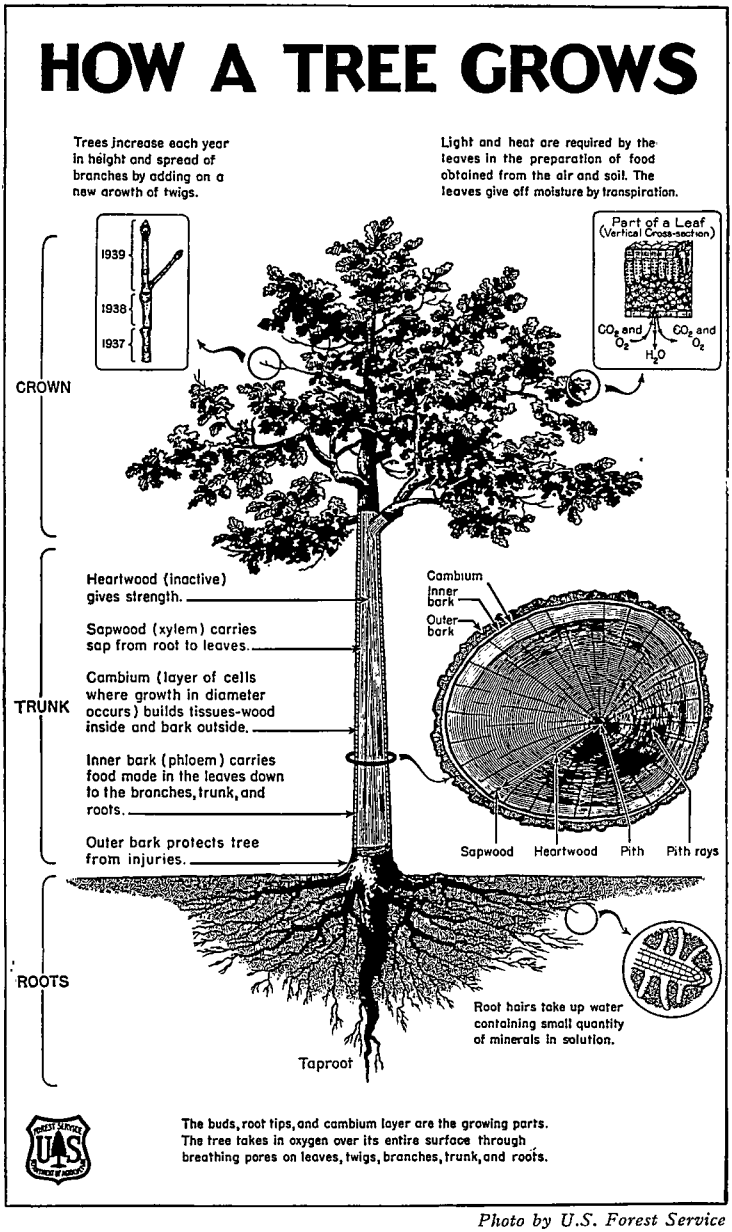
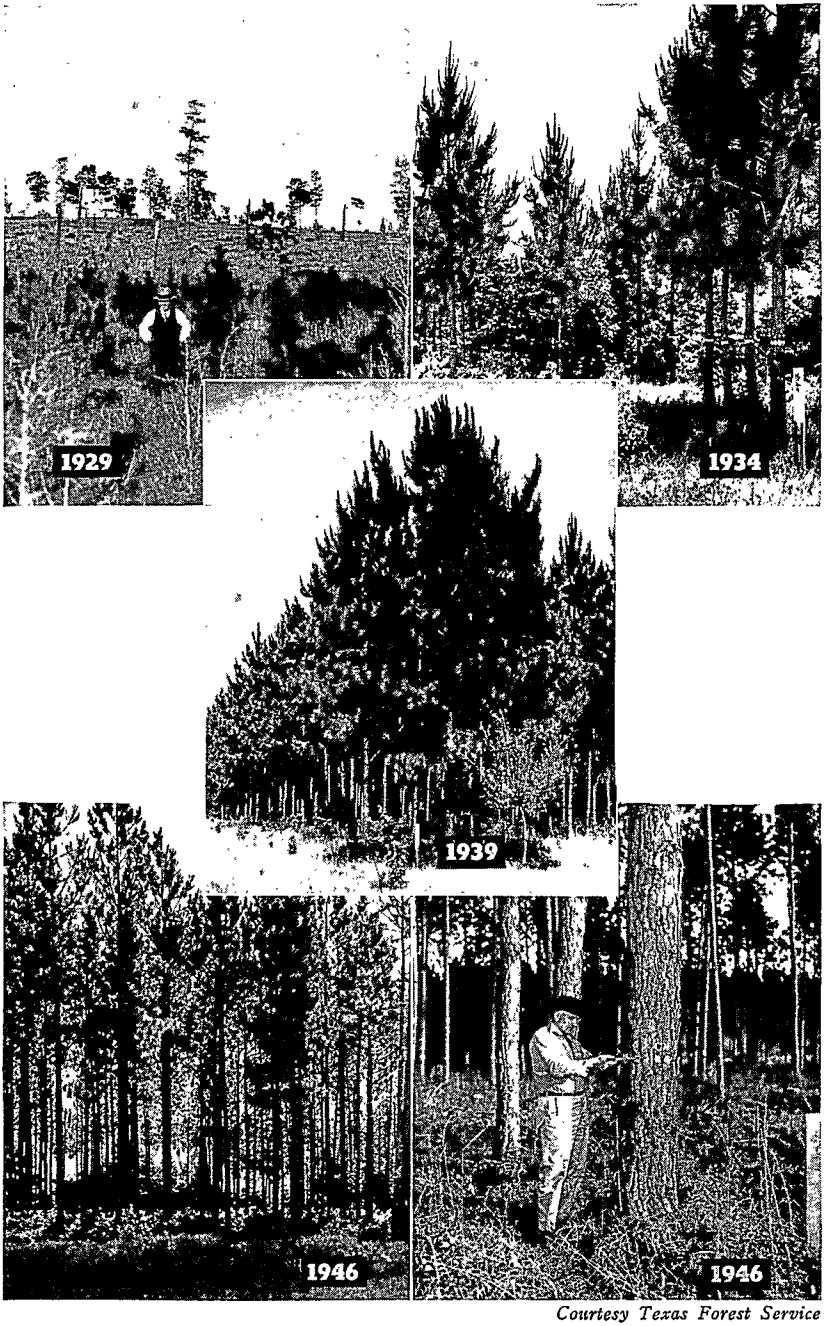


Photo by U.S. Forest Service

HOW A TREE GROWS



Courtesy Texas Forest Service

TEXAS PINE PLANTATION

The slash pines in these five photographs are part of the Siecke State Forest, and were planted in 1926 as an experiment.

by the fire—this being due to the different economic conditions prevailing at the time of the estimates.

Aside from long forward strides made in the field of fire control, the great hope for improvement in forest conservation is the timber owners' growing recognition of dollars-and-cents benefits to be derived from the pursuit of selective logging practices. Today a large and increasing proportion of all the industrially owned timber is being subjected to some form of management designed to keep the forest in a state of continuous production. The organized lumber manufacturing industry is on record as declaring: "The establishment of forestry practices suited to continuous forest production is an obligation of forest owners and of the industries using forest products," and this is the guiding principle of most large lumber operations today. A similarly enlightened code of forest practice has been adopted by the organized producers of pulpwood and paper. A generation ago foresters on a lumber company's pay roll were unheard of. Today 3,100 foresters are employed by the forest-products industries.

More and more of the large producers of lumber and pulpwood are harvesting their own timber on a basis which balances the cut with the growth; and, what is even more important, many of them have instituted programs of education among the smaller private owners of timberlands, mostly farmers, seeking to show them how they can by selective logging methods make their woodlands a steady source of annual income. One of their doctrines is emphasis on the fact that every tree puts on a new layer of wood annually; that every tree left standing gets bigger—and more valuable—every year. The industry has also shown farmers the folly of burning the woods.

An example—by no means unique—of this type of co-operative work is supplied by the educational program carried on by L. K. Pomeroy of the Ozark-Badger Lumber Company of Wilmar, Arkansas. Mr. Pomeroy, an enthusiastic believer in the value of forestry on his own company's lands and a practical forester of considerable renown, has made a hobby of showing the owners of land adjacent to the company's holdings that they can make more money out of their trees by following a system of management and selective cutting. His plan is to make a contract with the landowner whereby the owner agrees to sell whatever timber is cut to the Ozark-Badger company at market price. In return, the company agrees to manage the farmer's

land for sustained yield. When the farmer needs a little money, the company will cut a few selected trees and send him a check.

One Arkansas farmer a few years ago offered to sell all the timber on his land for $6.50 an acre. Mr. Pomeroy persuaded him to make a sustained-yield contract with the lumber company, as a result of which the farmer has received $8.50 per acre for the timber he has sold, plus the money paid him for his labor in cutting the logs, and still has an abundant supply of growing trees.

Mr. Pomeroy calls this "timber banking," and he now has more than a hundred "depositors" who are deriving a steady annual income from their "interest," the mature timber cut, while their "deposit," the growing stock, is held intact. Farmers, as a rule, are hard to change in their habits. Most of them have never thought anything about forestry, nor have they regarded trees as a crop. But when a practical forester discusses the matter with them on a dollars-and-cents basis they are quick to see the point. They see the value of a crop which, if properly handled, does not need to be planted or cultivated and can be harvested periodically and profitably. Too many of them, however, have never realized the financial importance of timber when handled as a crop.

When Mr. Pomeroy discusses forestry he speaks with authority. He is a forester-lumberman; he practices what he preaches and time has proved that his theories are right. For instance, in 1928 he bought a tract of timberland for his lumber company. A reputable firm of timber cruisers had estimated that the area would produce 2,980 board feet per acre. Since then this tract has been selectively cut three times: in 1932 the harvest was 1,200 feet per acre; in 1937, 1,660 feet; in 1942, 1,930 feet—a total cut of 4,790 feet per acre from a tract originally estimated at 2,980 feet. And, what is most impressive, a cruise in January 1943 showed a remaining stand of 4,880 feet per acre. Granting that this is remarkably good growth, nowhere except in sustained yield is it possible to get an equation like that: 2,980 — 4,790 = 4,880.

Another impressive experience of Mr. Pomeroy's, involving a tract of forty acres bought in 1930, showed equally significant results. This "forty" in 1930 was estimated to cut a total volume of 132,000 feet of pine. Within the next two years the operators cut off 50,124 feet of logs, and in 1932 a re-cruise of the tract showed that there were standing 4,300 trees containing a volume of 84,375 feet. By 1938 an addi-

tional 17,570 feet had been logged off; but a re-cruise in 1938 showed 2,930 trees amounting to 152,334 feet. By 1945 they had cut 49,007 feet more, but the 1946 re-cruise showed 4,220 trees on the tract, containing 229,337 feet. Within the next five years 46,069 feet of logs were harvested—but the re-cruise in 1950 showed 4,330 trees, amounting to 223,201 feet. In other words, beginning with a stand of about 3,300 feet per acre, the company has cut 4,069 feet per acre in four succeeding selective logging operations at five-year intervals—and now has on the "forty" an average stand of 5,580 feet per acre after the last cutting. Or, expressed another way, a total of 162,760 feet has been removed from a tract containing originally 132,000, leaving a remainder of 223,201 feet now standing on the tract—and meanwhile natural re-seeding has provided an average increase of 30 per acre in the number of trees.

Mr. Pomeroy's forest-management plans were so obviously practical and profitable that he soon found a demand for his advisory services from other lumber companies desiring to put their operations on a sustained-yield basis. One of his first clients was the W. T. Smith Lumber Company, owned by the McGowin interests, at Chapman, Alabama. This company, which owns 200,000 acres of timberland, largely pine, is now operating on a basis which insures perpetuity of its lumber business. Furthermore, Julian F. McGowin, in charge of the company's forestry and logging work, has formed a professional partnership with Mr. Pomeroy for the purpose of working out timber-management methods for other landowners, and they have prepared such plans for a large number of Southern lumber manufacturing companies, whose timber holdings cover several million acres.

Forty percent of all the privately owned forest land in the United States is in farm woodlands; a total of 76 percent is in ownerships not exceeding 5,000 acres. It is principally for the purpose of reaching these smaller timberland owners that the National Lumber Manufacturers Association and the American Forest Products Industries in 1941 conceived the idea of a "Tree Farms" program to be launched on a nation-wide basis under independent sponsorship by an appropriate organization in each state. The object of the program is to recognize and publicize the hundreds of thousands of acres of timberland now under productive management and thereby to encourage the owners of other timberlands to adopt sound forestry practices.

The basic idea behind this program is recognition of the impor-

tant fact that timber is a crop, and to emphasize it the word "farm" is used. The annual timber crop is worth more than the combined value of all the wheat and all the cotton, yet it has been produced with a minimum of care and planning on the part of the average timberland owner. Now, as a result of a sustained program of education and example, the time has come when this important crop is being considered in the light of present requirements and future possibilities.

The Tree Farms program is one means to this end. A Tree Farm is officially defined as "an area dedicated to the growing of forest crops for commercial purposes, protected and managed for continuous production." Membership requirements specify that the owner of a Tree Farm must "assure his willingness to use the land under his control for the production of forest crops; provide reasonable protection from fire, insects and disease, and from damage from excessive grazing; harvest forest crops from his Tree Farm in a manner which will assure future crops; furnish information when requested concerning the progress of his Tree Farm."

The Tree Farms idea originated on the West Coast in June 1941 with the establishment in Washington of the Clemons Tree Farm, which involves 160,000 acres. Since then the movement has spread rapidly to other parts of the West Coast, to the South and to other sections of the country. Already there are about 6,000,000 acres of timberland officially approved as Tree Farms in the states of Oregon, Washington and California, and 14,000,000 acres in the South. The nation-wide total is approximately 23,250,000 acres. Interest in the idea is growing steadily, with a considerable acreage known to be eligible for the Tree Farm designation. More than 94 percent of the industrially owned or operated forest lands in the West Coast region is now being left in productive condition after logging, and 53.5 percent of these lands is under some form of forest management. Approximately the same condition prevails in the South. There, according to figures recently compiled by the Forest Service, at least 60 percent of the industrial timber is being handled as a crop. This area, estimated to exceed 60,000,000 acres, comprises the South's potential Tree Farm.

Typical of the attitude of modern-minded timber owners in the Western area is the Diamond Match Company, which operates a 220,000-acre tree farm in northern California. Even before the Tree

Farm program was launched this company had adopted a program of selective logging and continuous yield and for some time had limited its timber cut every year to 25 percent less than the expected annual growth. During the past ten years the company has had an average annual cut of 36,000,000 feet, with a growth conservatively estimated by foresters as not less than 45,000,000. There are many similar examples in Washington, Oregon and California, ranging in size from 25 to 633,000 acres.

One of the largest Tree Farms in the country is that of the Weyerhaeuser Timber Company near Klamath Falls, Oregon. This farm consists of 506,000 acres of growing timber, and Oregon's Governor Snell presided at the dedication ceremonies.

To serve these West Coast Tree Farms the forest industry maintains a co-operative nursery at Nisqually, Washington, growing five million seedlings a year, which are used for replanting burned-over areas.

These progressive, forestry-minded companies' programs are not cited as unusual. On the contrary, similar practices characterize the operations of many of the industrial owners of timber in the West. They have seen the advantages of sound forestry and they are determined to manage their timberlands accordingly. There are exceptions, of course, but the wide-awake timberland owner desires to follow a plan of action which will assure him a continuous yield of forest products.

In the South the Tree Farm idea is now in operation in Alabama, Arkansas, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, Texas and Virginia. In the South the Tree Farm system was introduced in Alabama in the spring of 1942 with a celebration at Brewton (the home of one of the state's most enthusiastic tree farmers, the late W. T. Neal of the T. R. Miller Mill Company), attended by lumbermen, paper and pulp operators, farmers and timberland owners, large and small. Governor Dixon, in presenting the Tree Farm certificates and insignia to the initial group, emphatically expressed the view that "there is almost no limit to the benefits which perpetual forestry can bring to the state of Alabama." The same idea is shared by an increasing number of Alabamians—farmers with small wood lots and lumber companies with holdings running as high as 150,000 to 250,000 acres. Since the spring of 1942 more than 300 owners of forest land in Alabama have qualified as Tree Farmers,

their holdings aggregating about 2,500,000 acres. The state forester predicts that eventually 5,000,000 acres of productive forest land will be classified as Tree Farms and managed accordingly. An interesting elaboration involves a plan of co-operation worked out among the Alabama Tree Farms System, the State Board of Education and the state organization of Future Farmers of America. Forestry will be taught to about 15,000 students in the vocational agricultural classes of Alabama's public schools, and in addition the 7,000 Future Farmers in Alabama have launched a program on their parents' farms which will result in the planting of a million pine trees this year.

Alabama was a particularly suitable state in which to launch a Tree Farms program in the South, as it is one of the more progressive states from a forestry standpoint. More than 100 professional foresters are already employed by private timberland owners in Alabama for the purpose of organizing their forest properties on a sustained-yield basis. A number of the larger lumber manufacturing companies are now so operating, and serve as examples of its practical wisdom.

Leading sawmill operators and forest owners in Arkansas encouraged the introduction of the Tree Farms system, and Tree Farm display signs have been allotted to about 250 timberland owners in that state, representing more than 3,000,000 acres. Arkansas proved to be a fruitful state for the introduction of the Tree Farms movement, as many of its timberland owners are already conservation-minded. The state forester points out that the annual timber growth is already greater than the annual cut, so that Arkansas' timber bank account is now steadily growing instead of diminishing. Here also is the home of one of the nation's foremost examples of a completely integrated forest-products industry—the operation of the Fordyce-Crossett-Gates interests at Crossett. They operate a sawmill, a hardwood distillation plant and a kraft pulp and paper mill; and the basic raw material for all of them comes from the 500,000 acres of company-owned and managed timberlands. The current annual growth, under present management practices, is more than meeting all needs. Among other large sustained-yield operators in Arkansas, with industrial holdings of 100,000 acres or more, are the Frost, Bradley and Dierks interests, the Southern Lumber Company, and the Ozan Lumber Company.

The outstanding pioneer tree farmer in the South was Henry Hardtner of the Urania Lumber Company, Urania, Louisiana. This

company's 100,000 acres of pine and hardwood timber near Urania have been in continuous production for nearly forty years. Here pine saw timber is being harvested from land which was planted to cotton within the memory of men who are now cutting the trees. The furrows of the cotton fields are still clearly visible in the heavily timbered forest. Henry Hardtner was the first practical lumberman to practice tree-growing on a commercial basis. He was forestry's Moses in the South.

There are now Tree Farm systems in operation in ten Southern states besides Alabama and Arkansas, and Texas (naturally enough) boasts the biggest Tree Farm of all—a little plot of 683,497 acres belonging to the Southwestern Settlement and Development Corporation of Houston.

In addition to its Tree Farm promotion work, the American Forest Products Industries, Inc., is furthering the cause of conservation with two other related programs: "Keep America Green" and "More Trees for America." The "Keep Green" program, aimed primarily at forest-fire prevention, is now in operation in 29 states. The "More Trees" (or "Cash Crop") program is new and is now operating in only five states: Alabama, South Carolina, Virginia, New Hampshire and Vermont. It is directed at the small landowner and is designed to impress him with the wisdom of good woodland management and the value of his growing timber as a cash crop.

Methods of scientific forestry or logging for continuous production vary with different regions and different types of forest growth. Trees have a definite life span, depending upon species, soil, climate, topography and numerous other factors. The forester must be able to recognize all these factors. He plans to take advantage of them in managing the forest so that the maximum yield of forest products results, without injuring the productive capacity of the woodlands.

Southern forests are chiefly comprised of succeeding annual crops of trees springing from the seeds dropped (usually every year) by mature trees. Timber stands of this type are best harvested by selecting the mature trees, together with the undesirable and diseased ones, for cutting. The removal of these trees serves to release the remaining younger trees from crowding, thereby encouraging their growth. When it is necessary to harvest most of the desirable trees at one time, the forester is careful to leave on every acre a sufficient number of seed trees to provide new crops of seedlings. When the annual

growth has been determined, the forester is then able to regulate the annual harvest to an amount approximating this figure. If this policy is adhered to, the forest property is being managed on a continuous basis. Certain kinds of timber, however, do not lend themselves readily to it. Douglas fir, for instance, does not thrive in shade, and a fir forest is usually made up of trees of approximately the same size. When a forest of even-aged type is mature it is sometimes best to harvest by clear-cutting. Many of the objectionable features of this method of cutting may be overcome if the cutting is "staggered," or done in strips, with groups or blocks of the old trees left to reseed the areas which have been harvested. Every effort is made to have the groups or blocks well distributed over the area and, when possible, they are left in a position where the wind can be depended upon to scatter the seeds.

The necessity for planting trees is generally confined to reclaiming burned-over, badly eroded and clear-cut lands which are not properly restocking. In many of our timbered areas there is plenty of natural annual reseeding to insure successive crops of growing trees; and all that Nature asks is that these seedlings or saplings be given a chance to grow and develop. Adequate fire protection is essential, and they should have proper silvicultural treatment—such as thinning, weeding and perhaps pruning—in order to get a valuable raw product in the shortest possible time. Tree planting is not being neglected where desirable, however. In 1950, according to the United States Forest Service, a total of 497,500 acres was planted with tree seedlings. Of this total replanted area, 73 percent was on privately owned land, an increase of about 50 percent over 1949 planting. The total acreage of reforested land in the United States now stands at 7,200,000 acres.

It is now generally agreed that it is desirable and practical to maintain a continuous supply of timber. Opinions vary, however, as to how this ideal should be attained. Progress already made in this direction has been voluntary rather than compulsory, based on the demonstration that it is commercially feasible and profitable to handle timber as a crop. Through the slow but sure process of education and example the idea has spread. Some impatient conservationists, however, feel that this is too slow; they would achieve conservation quickly by governmental compulsion.

For a number of years there has been a persistent effort on the part of the United States Forest Service, a bureau of the Department

of Agriculture, to have legislation enacted providing for the Federal regulation of cutting practices on private timberlands. The chief foresters' reports year after year have recommended and urged such Federal regulation, and some have urged this as the only solution of the forestry problem. There is, however, a sharp difference of opinion among foresters and timberland owners on the subject of regulation. Many of them (including, naturally, most of the timberland owners) take the position that there should be no regulation at all and that progress in forestry should be accomplished by education and voluntary action rather than legislation. Still others hold that although some form of regulation may be necessary as a last resort, it should be in charge of the forestry departments of the states rather than the United States Forest Service.

Ten of the states already have laws controlling or influencing cutting practices, the private owners having taken the initiative in having such legislation enacted in some of these states. These state laws vary with local conditions. The law in California forbids cutting any tree under 18 inches in diameter. In Alabama there are principles of forest practice, promulgated by the Alabama Department of Conservation, which do not have the force of law but are merely recommendations. Between these two extremes there are state regulatory laws of varying stringency.

In spite of the continued agitation in behalf of Federal regulation, it has never been possible to muster sufficient strength in Congress to enact regulatory legislation. One reason advanced for the public's lack of confidence in the advisability of delegating forest regulation to Federal agencies is the record of failure of such agencies to use the power where they have had it. It is pointed out that the Federal government already has the power to regulate forestry on large acreages of farm land, through the Farm Security Administration, the Federal Land Bank and the AAA. But little or no effort has been made to enforce forestry practices through these bureaus where they would do the most good—that is, on the relatively small tracts of timber owned by farmers.

The AAA regulations provide specifically that payments may be withheld if the farmer-beneficiary pursues practices on his forest lands which are contrary to sound conservation practices. So far as can be ascertained, however, the government agencies have not attempted to comply with this clause. There is no case on record of farm-benefit

payments having been withheld on this account, and farmers convicted in the courts of setting fire to their own wood lots and permitting such fires to spread to adjoining property have continued to draw benefit payments.

The Farm Security Administration's chief reason for existence is to teach the farmers, particularly indigent farmers, to practice better methods; but the FSA does not require forest-fire protection or any forest-management plans as a condition of its loans and advances. A farmer may live on a farm which is mortgaged to the Federal Land Bank, draw conservation benefit payments from the AAA, and also receive payments from the Farm Security Administration, and still burn or denude his wood lot with impunity. There is grave question whether the lodging of regulatory power in one more Federal bureau would be effective in inducing such a farmer to leave some seed trees or a growing stock of timber on his land.

In the past there has undoubtedly been misuse of the forests. Some of it has been economically unavoidable, due to high taxes or the necessity for liquidation of an investment. Some of it has been due to shortsightedness and heedlessness. But in current discussions of forestry there is still too much emphasis on the past. The shortsighted cut-out-and-get-out policies which resulted in the abandoned cutover lands and the so-called ghost towns are being followed by a minority of the industrial owners of timberland today. More and more of them are operating along lines designed to insure a continuous crop of timber. Many of them have already achieved a balance between growth and use which insures the permanency of their operations. Others are seeing the light and adjusting their methods accordingly. Perfection has not yet been attained, and examples of improper exploitation may still be found. But the trend is definitely in the direction of conservation rather than exploitation. A continuation and widening of the trend (which it seems reasonable to expect), together with a policy of restoring submarginal lands to forest growth, will insure us an adequate supply of timber for our future needs.

Chapter IV

A NOTE ON THE NORTH AND EAST

The Northeast

THE Northeastern area—the New England states, together with New York and Pennsylvania—is the area of greatest lumber consumption but is of relatively minor importance as a producing section. Its total annual production is less than four percent of the nation's total, and practically all of it is consumed close to its point of origin. The principal softwood species manufactured are white pine, spruce and hemlock; the hardwoods are birch, maple and beech.

Although on a much smaller scale than in its heyday eighty or one hundred years ago, the nature of the business is very much the same as it was then. It is still seasonal; the logs are cut during the late fall and winter and transported to riverbanks, highways or mills over snow and ice roads. In this region will still be found a holdover, on a smaller scale, of the log drives in the springtime that characterized the logging operations of the Northeast in the early days, as the rivers still provide the most convenient and economical way of getting the logs out of some otherwise inaccessible tracts of timber.

One of the notable features is the continuing timber supply. Decades ago it was said that all had been cut out, and it is a fact that production in this region is relatively of less importance than before the Civil War. But there are still a considerable number of mills in the Northeast, and year after year they have been finding a sufficient supply of logs to stay in business. Production of New England sawmills was 1,140,613,000 feet in 1947—and it was only 1,400,879,000 feet in 1870. As a matter of fact, the Northeast probably has more standing timber today than it had forty or fifty years ago. The Forest Survey figures show that the timber is growing faster than it is being used, which means that every year sees an increase in the total stand. The National Resources Planning Board said in 1942: "Forests probably occupy a larger proportion of New England today than at any other time during the past century." Sustained-yield cutting has been

the practice of most of the timber owners in this region for a long time, and the supply will probably be augmented in the future by the timber available from idle and abandoned lands which are reverting to tree growth.

The Lake States

The Lake States enjoyed their great era of prosperity during the latter part of the last century, reaching their peak of production in the decade from 1880 to 1890. Since that time the trend has been sharply and steadily downward, with each year's production figures lower than those of the year before, until the late thirties when there was a slight upturn. Of the reported total production of 1,310,266,000 feet in Michigan, Minnesota and Wisconsin in 1947, about 64 percent was hardwoods and 36 percent softwoods. About 30 percent of the hardwood total was maple, and about 50 percent of the total softwoods was hemlock. The three states together produced a total of only 188 million feet of white pine, the kingly wood which made the Lake States famous in the early days.

It was the virtual exhaustion of the white pine timber supply in the Lake States which accounted for the decline of that area as a lumber-producing region of major importance. When those early white pine lumbermen said the timber was all gone, they meant that white pine was not available in the apparently inexhaustible boundaries they had found when they came there. Most of these big pioneer operators did not consider the remaining scattered small patches of white pine as worthy of their notice, and they looked on hardwoods and hemlock as little more than weeds.

In spite of the declining timber supply in the white pine region along the upper Mississippi and Lake Superior, there was still enough timber there in the early eighties to make overproduction a problem of the operators in that region. In 1884 an effort, which proved unsuccessful, was made to curtail the output of logs during the winter logging season, and there was some very violent criticism of those who persisted in bringing out a normal supply of logs in the face of a sluggish market. Those were the days of roughshod journalism, and one of the Northwestern lumber trade-paper editors thus admonished his readers:

You infernal, idiotic, crazy, demented galoots, why don't you stop? You may say you cannot see how you can live through the winter without going into the woods. Go into the insurance or real estate business in St. Paul or Minneapolis. Go to the poor house. Go and jump off the suspension bridge. But do not involve foolish and confiding friends into outfitting you for the woods in the hope that they or you can get a new dollar for an old one. If there is no other way for you to live in the world except to cut logs, then get out of it and join the angels.

This crackling admonition went unheeded, however, and the overproduction of logs and lumber continued unabated. The cut-out-and-get-out system of operation was the general rule in the Lake States in those early days of white pine lumbering, with the result that its abandoned, cutover lands, the prey to annual fires, have been a problem in these states ever since. On the other hand, the Forest Survey findings indicate a remaining stand of saw timber which is much greater than had been previously estimated: a total of 51 billion feet. This is sufficient to maintain the current normal volume of production for thirty or forty years, regardless of the accretion from natural growth, and the current annual growth of all commercial timber in this area is slightly more than the total drain.

Since the establishment of an organized fire-protection system in Wisconsin there has been a very noticeable improvement in natural reproduction throughout its timber region, and Michigan also has made a very creditable showing in this respect. Some of the paper companies are maintaining large plantations of conifers, and these will contribute to the future forest supply. Sustained-yield operations are not as general in the Lake States as in the parts of the country where growth conditions are more favorable, but some of the operators are experimenting with them.

Conspicuous among the Lake State companies that are operating on the basis of conservation is the Wisconsin Land and Lumber Company of Hermansville, Michigan, which has been producing lumber on the same site since January 1879—more than seventy-two years. They have tracts covering 33,000 acres operated as reforestation projects and some of this regrowth is already so close to the merchantable stage that the company's current plan is to establish a redesigned operation on a sustained-yield, permanent basis.

Minnesota now has a law regulating the cutting of timber, the specifications following closely those set up voluntarily by the lumber industry in Article X of the Lumber Code. Wisconsin also has a forest-crop law in effect, through which owners of lands primarily more useful for forestry than for other purposes may enter them in the records of the state's forestry department to be set aside for the growing of commercial crops of timber. Such forest-crop lands are thereafter subject to an annual tax of ten cents per acre and a ten-percent severance tax on such timber as is cut. The lumbermen and timberland owners co-operated in framing this law, and already some 150,000 acres of privately owned lands have been set aside.

The development of the rich timber resources of the Lake States produced some business giants among those early lumbermen. One picturesque and prominent figure was Russel A. Alger, who became Secretary of War under President McKinley. Mr. Alger engaged in the lumber business in Grand Rapids in 1860, just in time to be wiped out by the financial disturbance incident to the opening of the War Between the States. After serving four years—he enlisted as a private and emerged a major general—Alger went back into the lumber business in Michigan and was notably successful. He became the head of several companies, owning large tracts of white pine timber. When the merits of the Southern pine timber began first to be manifested, he organized the Alger-Sullivan Lumber Company, with extensive timber holdings in Alabama and Florida, which is still in operation there.

Other pioneer Michigan lumbering families were the Blodgetts, the Fordneys, the Herricks, the Yawkeys, the Bissells and the Rusts—to name but a few—all of whom prospered there and moved on to pastures new to figure in further timber developments.

Another outstanding pioneer was Dr. David Ward, who in 1883 was the owner of more than two billion feet of white pine timber in Michigan and Wisconsin. This, together with his other holdings, was estimated to be worth in excess of $25,000,000. A contemporary biographical sketch emphasizes his virtues of industry and frugality —especially the latter:

Whenever he earned a dollar, he invested it. No part of it went for tobacco, whisky or trinkets for personal adornment. He has never chewed, smoked or drank. He wears no jewelry, and does not even carry a watch. He takes no interest in yachts, fast horses or costly

paintings. Not a cent of his colossal fortune has been obtained in the whirlpool of destructive speculation. He has not risen on the crushed fortunes of others. When asked as to what he owed his success in life he replied: "To making the best of fine opportunities presented by the many fast-developing material resources of my time. My abilities were but a drop in the bucket. Seemingly I was born about the right time."

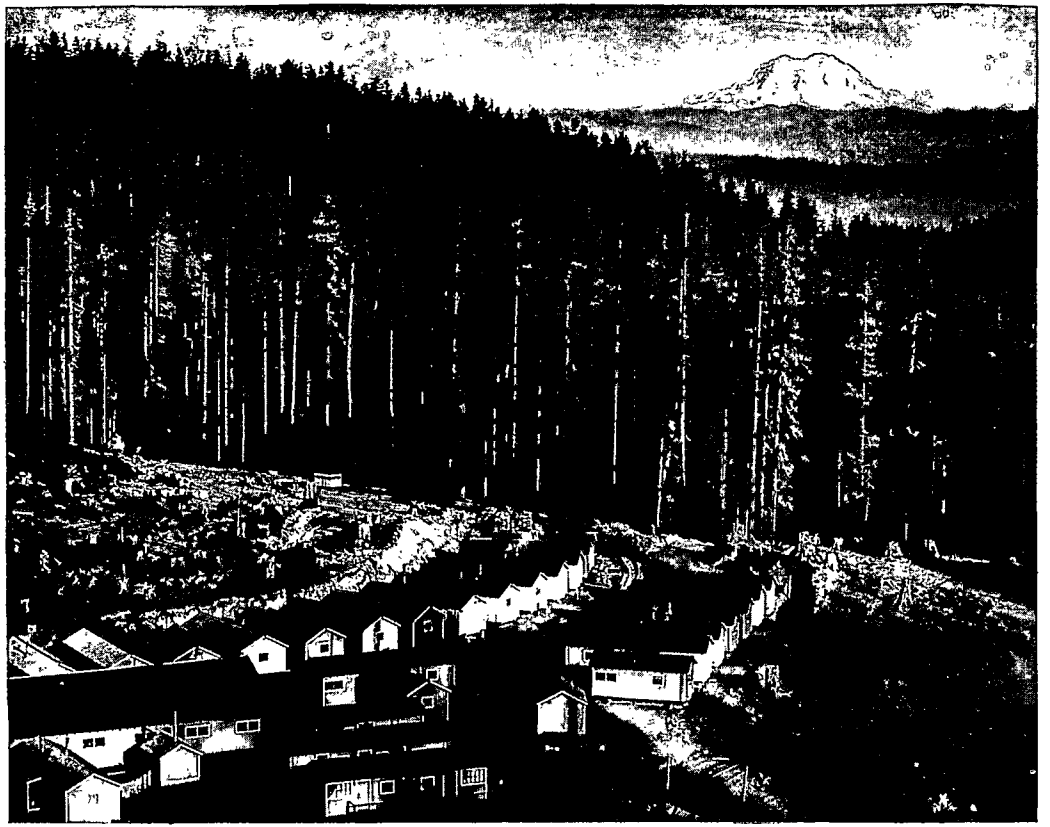
In the upper Mississippi country, in Minnesota, the lumber business was carried on by pioneer lumber families, and then by combinations of those families, such as the Carpenters, the Weyerhaeusers and the Brooks-Scanlon and Shevlin-Hixon interests.

Perhaps the foremost figure in the Minnesota trade, in the extent of his activities and in his lasting influence on the lumber business of the country, was Frederick Weyerhaeuser. He gained his first experience as a lumberman at Rock Island, Illinois, in 1856, and within a few years was operating a sawmill there in partnership with F. C. A. Denkman, under the firm name of Weyerhaeuser and Denkman—two names still familiar in today's lumber trade. Weyerhaeuser's interests steadily expanded; it was said of him that he would buy timber anywhere and sell it nowhere. With the depletion of the white pine stands of Minnesota his companies branched out and acquired extensive tracts in both the West and the South. These holdings included billions of feet of timber on lands measured in square miles rather than acres, and at the time of his death he was reputed to be one of the wealthiest men in the world. The Weyerhaeuser interests today embrace operations in Minnesota, the South and the Pacific Northwest.

The Central States

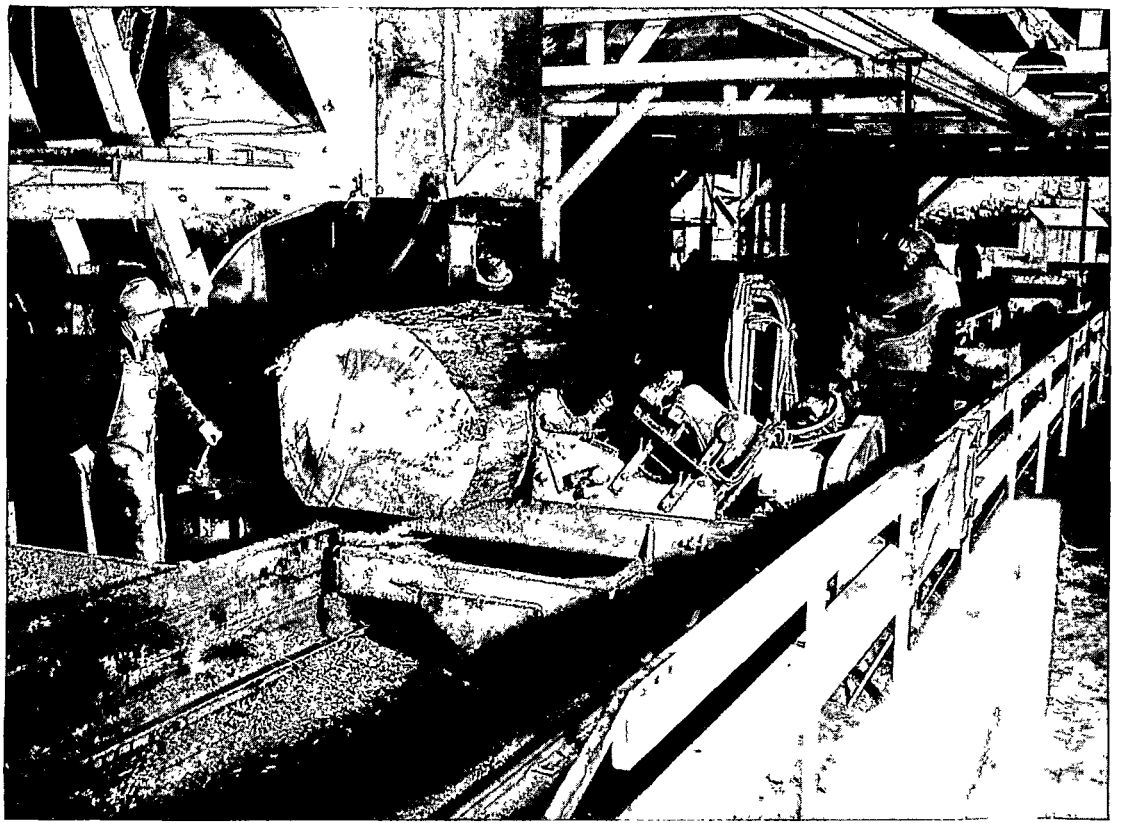
The Central States, a predominantly hardwood section, reached the top of their production about 1880, slipped back for ten years, then recovered to reach another high spot in 1900, and since then have been producing in lesser volume. In its day this region produced some of the finest hardwood lumber the country has ever seen. Indiana oak gained a reputation for quality which is still sustained by the handful of mills now operating in the Hoosier state. Black walnut and other varieties of hardwood timber abounded in the whole rich section. Much of this timber was developed as a by-product in

clearing lands for farming, but a considerable part of the acreage is still producing timber in recurringly steady though light crops, and there are a surprising number of sawmills operating today—937 in Indiana, 1,644 in Ohio and 1,155 in Illinois. Indiana, Ohio and Illinois produced, respectively, 180 million, 265 million and 100 million feet in 1947, most of it hardwoods of very high quality.



K. S. Brown Photo

WESTERN LOGGING CAMP SHOWING TIMBER IN BACKGROUND



LARGE LOG BEING SAWED BY BAND SAW WITH ELECTRIC DRIVE

Chapter V

LUMBERING IN THE WEST

"THE WEST," in the parlance of the lumber industry, refers to those eleven states from the Rocky Mountains to the Pacific Ocean: Washington, Oregon, California, Idaho, Montana, Wyoming, Colorado, Nevada, Utah, New Mexico and Arizona, also the Black Hills of South Dakota. This territory embraces only 23 percent of the total forested area of the United States, but in it is concentrated 65 percent of the nation's total footage of saw timber. The heaviest part of this stand is on the Pacific slope of Washington and Oregon—the wonderful intensified growth of Douglas fir timber, which is nearly equal to all the Eastern species combined. The Western timber is almost entirely coniferous, the hardwood species growing in small quantities of negligible commercial value.

The outstanding characteristic of the Western lumber industry is bigness. Trees grow bigger there than they do anywhere else on the face of the earth. Sawmills are bigger; the biggest mill in the world is the Weyerhaeuser mill at Longview, Washington. The Western manufacturers carry bigger stocks of lumber in bigger sheds; the logging operators use the biggest and heaviest tractors and trucks and the thickest wire rope. Everything they do is done in a big way.

Visitors to the Pacific Northwest have always been tremendously impressed by the gigantic size of the trees of this region. It is true today; it was true in 1804 when Captains Lewis and Clark made their history-making trip across the continent to the mouth of the Columbia River on the Pacific. "The whole neighborhood of the coast," the valiant captains wrote in their journal, "is supplied with great quantities of excellent timber. The predominating growth is the fir, of which we have seen several species. . . . The first species grows to an immense size, and is very commonly twenty-seven feet in circumference, six feet above the earth's surface: they rise to the height of two hundred and thirty feet, and one hundred and twenty of that height without a limb. We have often found them thirty-six feet in circumference. One of our party measured one and found it to be

forty-two feet in circumference, at a point beyond the reach of an ordinary man."

The first botanist of renown to visit the region was Dr. Archibald Menzies, who came in 1791, and first discovered and catalogued the tree now known as Douglas fir (*Pseudotsuga taxifolia*)—"a false hemlock with a yew-like leaf"—and he too marveled at its size. The tree was something of a botanical puzzle to Dr. Menzies, who found it to be similar to the spruce and the fir as well as to the hemlock and the yew—and modern botanists have not made much progress in solving the puzzle.

The next scientific visitor of record was David Douglas, prominent Scottish botanist, who arrived at Fort Vancouver in 1823 on a tour of exploration. He spent more than two years going through this country—and on the very first day of his survey discovered a specimen of the big tree which was later to bear his name. Douglas was the first to attempt a listing and classifying of the trees of the region, and the first to make known its tremendous forest wealth. It is fitting that he should have a living monument in the majestic Douglas fir.

The first steam sawmill on the Pacific Coast was built near the shores of Bodega Bay in 1843 by James Dawson. Dawson, while acting as master of a little trading vessel from Baltimore, had entered Bodega Bay in 1841 and for some undisclosed reason had been impressed with its attractive qualifications as a sawmill site. He accordingly returned to Baltimore where he acquired a complete outfit of sawmill machinery, hired a force of sawyers, millwrights and laborers, married and returned to California to become that territory's first lumber manufacturer. A little later Joseph Gale built a sawmill in Oregon, and in 1851 the first steam sawmill in Washington was built near the southern end of Puget Sound.

In general, the lumber production of the West naturally falls into three fairly well-defined groupings: Douglas fir and its associated species, such as Western red cedar, hemlock, and spruce; the Western pines—ponderosa, Idaho white and sugar; and redwood.

Douglas Fir and Associated Species

Nowhere in the world is there concentrated in such a relatively small area such a large quantity of timber as grows in the extreme northwestern corner of the United States. This strip of country in

western Washington and Oregon between the Cascade Mountains and the Pacific Ocean is 480 miles long and from 100 to 150 miles wide. Its total land area is about 55 million acres, and of that total area not less than 26 million are classified as commercial forest lands, with another three million of noncommercial forests. Here is the nation's greatest reservoir of old-growth saw timber, a stand of 505 billion feet. The stand here is principally Douglas fir, 62 percent of it being of that species, but there are also hemlock and Western red cedar and Port Orford and white cedar and spruce, and other minor species such as noble fir and white or silver fir. The district produces 25 percent of the nation's lumber, 93 percent of the shingles, 17 percent of the wood pulp and 90 percent of the nation's commercial softwood plywood.

Ownership of this great forest area is divided among some 40,000 individuals and firms. Only about half of it is privately owned, the remainder being held by the Federal, state, county and municipal governments. Nearly ten million acres are either owned or managed by the Federal government.

The Forest Survey of 1945 showed that about 13 million acres of the 26 million of commercial forest land were at that time in coniferous timber of saw-log size; four million were of less than saw-log size, three million acres of seedling and sapling growth and about five million acres of burned and recently cutover lands.

The current annual depletion of saw timber from all causes in this region was given in the Survey report as 12,006 million board feet, of which 11,700 million feet were cut for lumber or some other product. The current annual growth was given as about 3,741 million feet, although it was estimated that the potential annual growth under intensive forest practice is approximately 8.2 billion board feet. As a matter of fact, industry foresters estimate that once all the stagnant old-growth stands have been converted into growing forests, the potential realizable annual growth of the Douglas fir region will probably reach 13 billion board feet.

The forestry problem in the Douglas fir region is complicated by the fact that the mature, old-growth forests (whose trees are from four hundred to seven hundred and fifty years old) are almost static as to growth. They grow very slowly, and whatever increase in volume they make by growth is largely offset by decay and mortality. They are ripe—some of them overripe—and ready for the harvest; if

they are not cut soon they will fall victims to decay, deterioration and death. As they are harvested, however, they are replaced by young, fast-growing trees, and thus the regional growth rate steadily increases. Statistics show that during the past ten years there has been an average annual increase in growth of 1,360 million board feet. It is estimated that the potential growth, when all the forests of the region are in a growing condition, is greater than any long-term withdrawal based on past use or foreseeable needs.

Well-informed students of forestry conditions on the West Coast believe that these rates of growth can be easily maintained and even exceeded, with development and steady improvement in logging practices, timber utilization, and protection against fire. In fact, it is confidently predicted that if the annual cut in the future can be maintained at about ten billion feet annually, there will not be much disparity, if any, between the cut and the growth.

In a recent article in *American Forests*, E. H. MacDaniels, veteran forester and former member of the staff of the United States Forest Service, comments optimistically on the outlook. He points out frankly that early development was based on the philosophy of forest inexhaustibility, and that this was followed by the era of forest liquidation, with most private owners thinking principally of converting their timber assets into cash. Some of this, he admits, is still going on; but he emphasizes that there has been of late years a very noticeable inclination on the part of timberland owners, particularly the larger ones, to place their forest properties on a permanently productive basis. Discussing this modern trend, Mr. MacDaniels says:

> There is still in the region plenty of poor lumbering, but 26 million acres of land cannot be changed overnight from wild to managed forests. Nevertheless, change is in progress at an increasing rate, particularly on the most productive and most accessible lands where economic conditions cushion some of the difficulties. Last year private owners were employing fifty-five professional foresters for forest management work in the woods. Another ninety were engaged in forest research and production. More and more the private owners and the region as a whole are awakening to the fact that timber cropping in the Douglas fir region as a private enterprise offers a sound and profitable long-time business.

What Mr. MacDaniels says is true. It is obvious to any impartial observer that the lumber operators and timberland owners of the

West Coast in increasing numbers have become converts to the gospel of industrial forestry, and the philosophy of conservation is characterizing more and more of their operations. Substantial evidence of the industry's belief in such practices is shown by its maintenance of a co-operative nursery which produces nine million tree seedlings every year for replanting burned-over areas, the organization of more than 400 Tree Farms with a total of 7,536,191 acres, the adoption of voluntary codes of forest practice for the reseeding of cutover lands, the expenditure of $15,000,000 per year on the control of fire hazards, and other constructive forestry measures. Lumber operations are gradually changing over to a basis of permanence, and some of the operators are so confident that they have mapped out definite area cutting schedules for their timber extending over the next hundred years. And, incidentally, the operators are today employing professional foresters in much greater numbers than at the time of Mr. MacDaniels' article—about 250 tree-growing foresters in the employ of the industry, plus an additional 400 engaged as logging engineers, research men, technologists, etc.

The present West Coast lumber industry is hardly a century old. The first effort at commercial development was back in 1788 when Captain John Mears, an intrepid seaman and trader, loaded his windjammer with logs and set sail for China. He never got there with his cargo, but he had the right idea; he knew that these giant trees, growing thick as the hair on a dog's back, were valuable, and soon there were others who had the same notion and followed in his footsteps in an effort to develop this natural wealth.

The first sawmill (water driven) was built in 1827 on the Columbia River near Fort Vancouver by John McLoughlin, of the Hudson's Bay Company. Then, with the opening of the Gold Rush to California in '49, there came further progress. News of the vast forests of towering Douglas firs was reaching the ears of lumber operators in the East. Some of the more valiant came around the Horn on sailing ships, bringing their machinery with them, and soon the shores of Puget Sound and other inlets from the Pacific were dotted with sawmills.

It was not until the latter part of the nineteenth century, however, that the real exploitation of the timber resources began, with the influx of the operators who were cutting out their holdings in the Lake States. They had heard about these big stands of timber that

would cut 30,000 feet to the tree, but they had set them aside as bunkhouse myths, and worked away at the "inexhaustible" tracts of white pine which surrounded the Great Lakes. But along in the eighties and nineties these inexhaustible forests began to be exhausted. The sawmill operators had to look elsewhere for timber, and they journeyed to the West Coast to have a look at those big trees. They came, they saw and they were conquered. Soon the lumbering families whose names had become famous in Maine and in Saginaw and on the upper Mississippi were established on Puget Sound, on Gray's Harbor and along the Columbia River. The development of the Northwest was under way, to grow gradually to its present position of dominance in the trade.

One of the first big-scale operators to recognize the possibilities in the timber resources of the Pacific Northwest was Colonel Chauncey W. Griggs. Colonel Griggs commanded a Minnesota regiment in the Union army, and after the war engaged in the coal and iron business in St. Paul. In 1887 he went to Tacoma and there, in company with A. G. Foster, Henry Hewitt, Jr., Charles H. Jones and others, organized the St. Paul and Tacoma Lumber Company, which is still active and prominent in the West Coast trade. This company acquired large holdings of timberlands in Washington, built a big sawmill at Tacoma, and Colonel Griggs was one of the first to introduce fir lumber and Western red cedar shingles into the markets of the East.

Another West Coast lumber pioneer, one with a far-reaching lumber background, was Harry McCormick, who organized the H. McCormick Lumber Company in Washington in 1896. Mr. McCormick was a native of Cherrytree, Pennsylvania—that lumbering town on the Susquehanna which was not only an important lumber center a hundred years ago, but is famous in logging folklore as the home of "Cherrytree Joe" McCreery, the hero of many logging ballads. Mr. McCormick's great-grandfather built the first sawmill in Pennsylvania, at Stone Valley in Center County, and in entering the business on the West Coast he was carrying on the traditions of one of the oldest lumber families of the country.

The utilization of timberlands and the manufacture of lumber—and other forest products—was developed in the Pacific Northwest along a pattern different from other sections. Here there were in the early days, to a greater extent than elsewhere, sawmill operators who

owned no timber and timber owners who owned no sawmill or other conversion plant. As a connecting link there were active open log markets—on Puget Sound, Gray's Harbor, Willapa Bay and the Columbia River—which provided an outlet for the logs of the non-manufacturing timber owners and a source of raw material for the lumber manufacturers (and other forest industries) who did not own timberland. Since World War II, however, there has been a change in this pattern; most of the manufacturers of timber now own their own timber, and less than 15 percent of the logs are now produced by commercial loggers. These sawmills have another source of logs—the extensive forests owned by the Federal government, by the Indians and by other public holders; also at times they import logs from Canada.

Whether they are logging their own lands to supply their own sawmills or are producing logs to be sold on the open market, the operators of the West Coast meet difficulties encountered nowhere else. The oversize timber and the rugged nature of the country combine to create a problem which challenges the ingenuity of the logger —and the West Coast logger is full of ingenuity. He has called to his assistance the latest and best—and biggest—mechanical equipment, and he uses the most highly paid and most skillful labor employed in the industry. His operation is highly mechanized, but to run it he must still depend on man power—men who are the spiritual if not the physical descendants of those who manned the log drives in Maine and whose calked boots splintered the softwood sidewalks of Saginaw.

The West remains the last stronghold of the picturesque phases of logging and lumbering. Here are to be found the colorful characters and activities which have always been associated with lumber operations in the public mind. They still talk out here in the loggers' strange, bright jargon, of bull buckers and whistle punks and choker men and cat skinners and wanigans. The color and the romance are still here, but they are different; there is no exact counterpart for the onetime brawling, swaggering individual who served as a logger or lumber worker in the old days, the untamed terror of the skid road. The hell-roaring era, of which Stewart Holbrook and others write so engagingly, is now just about a thing of the past.

The loggers of today are still real he-men, with hair on their chests. They still chew snuff—which they call "snoose"—and drink their

hooch and make no pretense at being tin angels. But the modern logger has a different outlook on life. He realizes that the industry, of which he is a vital and essential part, is in a period of transition, switching over from its former unsatisfactory nomadic life to a settled existence; and he is changing correspondingly.

Many of the modern workers in the woods are married, live in their own homes with their wives and children, and drive to and from their work every day in their own automobiles, like any other workers. Those in the camps close to the job live in an entirely different way from the shanty boys who crowded the crude bunkhouses of the pioneering days. The modern logging camp usually consists of a group of individual bunkhouses with only two beds in each house and clean sheets on the beds. But for the telltale calk marks on the wooden floors, you might think you were in a room in a college dormitory. There are radios and plenty of shower baths with hot water, modern toilet facilities, and everything is spick and span and spotlessly clean. The bunks cost the lumberjacks 15¢ per night and the meals 75¢ each—meals that would cost $3.00 or $4.00 at a city hotel, if you could get them at all.

Chopping down trees and loading logs are hard work, and a man who spends the day at them accumulates an appetite. The appetites never go unappeased, however, for these meals leave nothing to be desired in either quality or quantity. It is good food with a wide variety of dishes, well balanced as to calories—and there is lots of it. A typical menu runs: oyster stew, roast beef, pork chops, fried fish, potatoes, stewed tomatoes, string beans, baked beans, celery, pickled beets, dill pickles, coffee, tea, milk, bread, rolls, pudding, apple pie, coconut cream pie, rice pudding, two kinds of cake, and cookies. This is only a midday lunch. In the evening they eat a real man-sized meal. Everything is served in heaping platters, constantly replenished, and there is no limit to what any logger may eat. The only rule of the cookhouse is that the meal must be eaten in silence, and this does not require much enforcement. The men are hungry; they come there to eat, not to talk. The operators serve these lavish meals at less than cost, but it is a loss they cheerfully suffer. With wages pretty well standardized, it is the only extra inducement that can be offered the lumberjacks, and rival outfits vie with one another in serving the biggest and best meal for the least money.

The physical difficulties encountered in production are not the

Northwestern lumberman's only trouble. He has the great advantage of operating with a plentiful amount of big timber. He is the automatic source of supply for those who want to buy lumber and timbers in large sizes and long lengths. But he has the misfortune to be at a long distance from the principal consuming territories, east of the Mississippi River, and transportation has always been a major factor in his merchandising problems. During the earliest days of the Northwestern industry its markets were close at home, a large part of the output of the mills being sold in California, where the lumber was shipped in coastwise vessels. With the coming of transcontinental railroads markets of the prairie states were made available, and as this section experienced its rapid growth it furnished an outlet for much of the lumber in the Douglas fir region. In 1913, 78 percent of this lumber was consumed west of the Mississippi River, but now the proportion sold there has shrunk to about 50 percent.

This change in marketing territory was due largely to the opening of the Panama Canal, which cut down the sailing time from Puget Sound to North Atlantic ports from seventy to twenty days and so opened up the markets of the Eastern seaboard to the mills of the Pacific Northwest. There had always been some water-borne shipment by vessels sailing around Cape Horn, but the Canal reduced the transportation cost by 50 percent and made possible the active growth of intercoastal business. It was necessary first to establish distributing centers at the principal Eastern seaports that could handle the cargoes of these intercoastal steamers, which carried five or six million feet, but then the West Coast lumber began to move through the Canal in large volume. The traffic became a measurable factor about 1920 and reached a peak in 1928, when the total shipments to the Atlantic Coast via the Canal amounted to 1,681,927,000 feet. It dwindled during the depression years of the early thirties, but had been increasing again before World War II started. In 1940 shipments by the Canal route were running above a billion feet per year, and the lumber tonnage was greater than that of any other commodity shipped through the Canal. Many of the tidewater fir mills depended on the East for marketing the bulk of their production. The intercoastal trade was shut off during the war, but by 1949 it was back up above the billion mark again.

This traffic has been one of the most important features of the Douglas fir trade in recent years. It took care of that part of the

mills' cut which could not be efficiently marketed closer home. Distributing yards at such points as Baltimore, Newark, Providence and Boston have not only been able to serve the consuming trade in their immediate vicinities, but have also made shipments as far inland as Detroit, Cleveland and Cincinnati. Most of this trade is in common boards and dimension; the kiln-dried higher grades are generally shipped by rail on account of the greater protection afforded by railroad cars.

Before Pearl Harbor the mills of the Pacific Northwest enjoyed also a considerable export trade in lumber and logs, largely with Japan, China, Great Britain and South America. Japan was an early convert to the possibilities of veneer and plywood, and many cargoes of fir "peeler" logs and sawed "Jap squares" for Japan's lumber and veneer mills moved out of the Pacific ports in prewar days. Since the war the export trade has been but a fraction of the prewar volume.

Lumber production in the Douglas fir region is a much more complex manufacturing process than in most other sections. Fir is a versatile wood, available in sizes not procurable in most competing species, and a large variety of items, grades and sizes are cut to satisfy many different classes of trade all over the world. "The large sawmills," says the Forest Survey report, "produce hundreds of different patterns of molding and interior finish; flooring of many kinds and sizes, ranging from 1″ x 4″ boards for ordinary dwellings to ship and bridge decking; ceiling, siding and boards; dimension lumber of many sizes; large timbers for oil derricks, bridges and other types of heavy construction; factory lumber; railroad ties; and many other items."

Most of the mills produce also a few by-products, such as lath; and mills within reach of the larger cities have a ready market for much of their waste in the form of fuel, either as hogged chips or sawdust. To a greater extent than in any other part of the country the industries and homes of such cities as Seattle and Portland use this wood-waste fuel, and sawdust-burning furnaces are common.

Utilization of previously wasted material has increased tremendously within the past few years. There are now about 50 chipping plants at sawmills in the Douglas fir region in which slabs and edgings are hogged into chips and the chips shipped off to the nearest pulp mill for conversion into pulp. The leftovers from many sawmills are now being used by the ten or more hardboard and softboard plants now in operation. Leftovers from plywood plants are also used for

these purposes. The march toward greater utilization of raw material in the wood manufacturing plants of the West Coast has constituted an outstanding story of industrial progress in the last decade.

A unique product of Western lumbering conditions is the "gyppo" logger or lumberman. "Gyppo" is a regional slang word to describe the small operator, either in logging or sawmilling, who takes a contract to log a tract of timber for its owner at so much per thousand feet, or else buys a small lot of timber and logs it himself. He works on a small scale and may be here today and somewhere else next week. The term is in no sense a reflection on character or integrity; the gyppo is a sort of Western counterpart of the Southern peckerwood operator.

In the aggregate the gyppo loggers provide a valuable source for the log-buying mills, and the gyppo sawmills produce a lot of lumber. The gyppos were particularly helpful in connection with the sudden wartime demand for aircraft spruce. Spruce comprises only one percent of the commercial timber stand of the Northwest, and the trees have an unfortunate way of growing singly or in small scattered stands in isolated localities; only two West Coast operators have spruce timber in any appreciable volume. This makes it difficult to log and produce spruce by ordinary means, but the trees couldn't hide from the energetic and resourceful gyppo. Equipped with his truck-and-trailer logging outfit and a falling crew, he scoured the countryside until he located some spruce, either a single tree or a small tract. On the spot he would negotiate for its purchase, cut it down and haul the logs to the nearest sawmill operator who was cutting aircraft spruce—and who was mighty glad to see the gyppo's truck drive up!

The resurgence of the demand for spruce aircraft lumber during World War II was one of the most interesting of the wartime developments in the West Coast industry. Most of the mills specializing in this stock—sometimes referred to as the "jewelry" of the lumber trade—installed special subsidiary equipment for its production. In the first place, the spruce logs intended for aircraft stock must be carefully selected for size and quality, with particular emphasis on straightness of grain. Aircraft cants are cut by the head saws, and are then conveyed to the aircraft-lumber department. Here the cant is carefully inspected to determine its "grain line." Digging a splinter out of the surface of the wood reveals the angle at which the grain runs,

and the grain line is marked on the surface of the cant with a straightedge. Straight-grained aircraft lumber is then produced from these cants by a small band mill, the cants being set on the carriage so that the saw line is parallel to the grain line. As the lumber comes from the mill a certified inspector grades it into its proper classifications and after that it is separated as to grade.

The scarcity of spruce in the Oregon and Washington forests led to plans for developing it in the National Forests of Alaska. A Federal agency was set up in 1942 to carry out this "Alaska Spruce Log Program," and in January 1943 the first fruits were visible in an ocean-going raft of a million feet which successfully made the 900-mile trip down the Pacific Coast from Edna Bay in Alaska to Puget Sound.

An incidental result of the scarcity of aircraft spruce was the increased recognition which has accrued to two of the onetime "ugly duckling" woods of the Pacific Northwest—hemlock and noble fir. These species were contemptuously referred to as "weed trees" by the early timber cruisers, but they had been gradually assuming importance before the war as their good qualities were more widely noted. Then came the demand for aircraft spruce and the difficulty of locating enough spruce, and then a search for substitute species and the discovery that noble fir and hemlock could be used right along with spruce for aircraft stock, with no perceptible difference in quality. Noble fir has the pleasing asset of being relatively free from twisted grain, and hemlock has the great virtue of growing abundantly. With the recruiting of these two species to bolster up the supply of Sitka spruce, the Northwest now has a large supply of high-quality timber suitable for aircraft material.

Only a relatively small portion of the timber of Washington and Oregon is of the species known as Western red cedar—24 billion feet out of a total of more than 500 billion—but, due to its outstanding natural qualities, it is one of the most important commercial woods of this area. It grows along the Pacific Coast, from Alaska to California, but 90 percent is in Washington and Oregon west of the Cascades. Along with cypress and redwood it belongs to the "durable woods group," and is peculiarly adapted to uses involving exposure to the weather. Its durability has, in fact, brought about its virtual monopoly of the wood-shingle field. Ninety percent of all the wood shingles are

of this species. It is popular too for siding in home construction, and for other purposes where durability is of prime importance.

The lumbermen and timberland owners of the Northwest have accomplished much by co-ordinated effort in fire prevention, control and salvage. They learned their forestry, the ABC's of timber cropping, the hard way, but all along the line they have assumed an advanced position. They have taken an active part in initiating and supporting the conservation regulations in force in Washington and Oregon. The industry has been going through a painful transition period from liquidation to sustained yield. The practical difficulties in the way of making this change are great, but the leaders think it can be achieved. The timber owners are making headway, even though they still have a long way to go.

The future of the lumber industry in the Pacific Northwest is mostly a matter of economics. As the mature timber is harvested the growth of the remaining stand will increase. When all of the region's 26 million acres of forest land are stocked with growing trees growth will equal the present cut, even under the old, outmoded practices of thirty years ago. If the lands are cut and protected from fire, as they are at present, the growth should be about ten billion feet per year. If future markets for lumber are sufficient to justify and sustain intensive forestry, experts say that this region could produce about 14½ billion board feet annually—nearly one-fourth more than the current drain.

One factor favorably affecting the outlook for forestry is the closer utilization of trees which has been steadily developing and which has been a strong influence in stimulating interest in Tree Farms and permanent forest industries. There has been, chiefly within the last twenty years, a large production of sulfite pulp from hemlock and the true firs, also the production of high-grade "dissolving" pulps, used for products like rayon and nitrocellulose. In all the West Coast tidewater districts hemlock sawmill waste is now converted into pulp chips and used by one of the twenty-three local pulp mills. Recently the use of Douglas fir mill waste for sulfate pulp has been perfected, and this will provide an outlet not only for the mill waste but also for the defective, low-grade Douglas fir logs now left in the woods. On the West Coast, as elsewhere, waste of a substantial

part of the timber has been a serious problem. Modern industrial processes now convert portions of that waste into salable products which help pay the cost of growing the trees, and are a powerful aid to timber cropping.

The Western Pines and Associated Woods

"Western pines" is the collective name applied to the three leading pine species growing in the West: ponderosa pine, sugar pine and Idaho white pine. In discussing these species the lumbermen and foresters generally speak of "Western pines and associated woods," the associated woods being white fir, larch, Engelmann's spruce, lodgepole pine, incense cedar, inland red cedar and Douglas fir of the Western pine region. Their area includes the eleven Western states and the Black Hills of South Dakota.

Ponderosa pine, the predominating species, is well distributed all over the timber-growing sections of this area, its natural habitat being greater than that of any other American wood. Sugar pine grows only in northern California and southern Oregon. Idaho white pine is found in northern Idaho, eastern Washington and western Montana —the so-called "Inland Empire." Other species found here are larch, Douglas fir, white fir, Engelmann's spruce, lodgepole pine, incense cedar, some Western red cedar and hemlock; but these species provide less than a fifth of the area's total lumber production.

Captains Lewis and Clark were the first to record the discovery of the big trees of the Western pine region, but the names of two of the three species were given them by David Douglas, who rediscovered them in 1827. *Pinus ponderosa* was naturally suggested to him by its ponderous size. To the sugar pine he gave the botanical label of *Pinus lambertiana,* in honor of his fellow botanist Sir A. B. Lambert, who later returned the compliment by naming the Douglas fir. The Idaho white pine is known to botanists as *Pinus monticola.* The latter two species are classified botanically as true white pine. The ponderosa, although not a white pine, is classified as a "soft-textured" pine. All three are commercially valuable and have a wide field of usefulness.

Because lack of transportation kept the forests inaccessible, commercial development of the Western pine area did not begin so early as in the Douglas fir region on the West Coast. The first sawmill in

this territory was a water-powered, sash-saw mill built at Lapwai in Idaho in 1840. The Reverend Henry H. Spalding, a Presbyterian minister to the Nez Percés Indians, conceived the idea of erecting a mill, and the Indians did the work, even digging the millrace. Their water wheel was constructed of Idaho white pine and cedar, and the saw was obtained from the McLoughlin mill at Fort Vancouver by Marcus Whitman and carried to Lapwai by canoe and horseback. Better known in history, however, is the first pine sawmill in California, built at Coloma in 1847. This was the famous Sutter's Mill, where gold was discovered in the tailrace by the operator of the mill, James W. Marshall. During the early sixties a few pine mills were started in Idaho and eastern Oregon, and with the coming of the transcontinental railroads the installation of sawmills increased rapidly. By 1869 their production of lumber had reached a total of 357 million feet.

All three of the Western pines grow large, but largest of all is the sugar pine. Trees from four to seven feet in diameter are common, and some sugar pines reach a diameter of 12 feet and a height of 250. They have a cone to match their giant size—as much as 20 inches or more in length. Idaho white pine trees will run, on the average, from two to four feet in diameter, and as tall as 180 feet. Ponderosa pines are sometimes eight feet in diameter and 200 feet high, but more commonly three to four feet through and 150 feet tall.

The total amount of standing timber in the Western pine region is 481 billion feet, a little less than half of which—225 billion feet—is of the three commercially prominent species. The total lumber production in the three species in 1947 was 6,729 million feet, about 85 percent of which was ponderosa pine.

These soft-textured pines are relatively light in weight, 1,900 to 2,000 pounds to the thousand feet in inch dressed stock. They do not have strength values as high as those of the harder, denser woods, and are not recommended for heavy timbers and other softwood uses requiring an exceptional degree of strength per unit of size.

Ponderosa pine is one of the most important and widely used of all softwoods. It is the most widely distributed conifer in the United States and with its total stand of 250 billion feet ranks second only to Douglas fir in saw-timber volume. The Forest Survey report says of it: "The wood is moderately soft, light in weight, fine-grained and easily worked. Its excellent properties make it valuable for interior

finish, sash and doors and boxes. It is also used for sheathing, small dimension and siding." It might be added that most of the stock window frames are made of it. Large annual production—more than three billion feet—makes it available in ample supply not only for retail yards in practically all sections of the country but for industrial or factory uses which absorb about half the total production.

The heaviest stands of ponderosa pine timber are found in eastern Oregon and California but it is also scattered in commercial quantities throughout the whole Western pine territory. Arizona and New Mexico are not commonly thought of as lumber-producing states. They have, however, five mills, each producing over ten million feet annually, and 218 smaller mills, and between them they yielded 346,942,000 feet of lumber in 1947—most of it ponderosa pine. A large portion of both states is arid, desert land, but in the mountains at an elevation of from 6,000 to 7,000 feet there is a belt of ponderosa pine timber of good quality. Elsewhere the stands are found at an average elevation of 3,500 feet.

Idaho white pine and sugar pine are produced in smaller volume and their use and distribution are correspondingly limited. The former finds its principal markets in the Middle West and East, where white pine is traditionally popular. It is the wood used for practically all the wooden matches made in this country. The sale of sugar pine in the lower grades is mostly in California, near the point of production, but the upper grades are widely distributed.

White pine has always been the foundryman's favorite wood for making patterns. This is one of the most exacting uses to which wood is put. Every large metal casting must first have an exact pattern carved in wood which is used to make the sand mold into which the molten metal is poured. The patternmaker demands a wood that can be carved easily and accurately, is light in weight, will hold its shape and may be readily nailed or glued—and the white pines fulfill these requirements. As the supply of Northern white pine (*Pinus strobus*) has dwindled, sugar pine and Idaho white pine have been drawn on more and more until now a very high percentage of the patternmaking requirements is of these Western woods.

Another increasingly extensive utilization of ponderosa pine and Idaho white pine is for paneled walls, either in clear boards or in the knotty stock which has been very popular with interior decorators. White pine was the species employed by the earliest New England

colonists, and the much-prized effects of that early paneling can be reproduced in these soft-textured pines from the West. The Department of Commerce has this to say about their appearance:

The heart-wood of all the Western pines is light in color, varying from creamy white to straw or pale reddish brown. Idaho white pine and sugar pine have very inconspicuous grain. Ponderosa pine shows a somewhat more abrupt transition from springwood to summerwood, so that after machining it presents a delicately figured grain. Even in ponderosa pine, however, the grain is much less evident than in many other softwoods. Knots in ponderosa pine are yellowish brown to cinnamon brown in color, while those of Idaho pine have a distinctly dark-reddish cast, quite different from ponderosa knots. Sugar pine knots characteristically grow a dark purplish brand around their edges.

The non-pine trees make up nearly half the timber stand of the Western pine region, but these furnish a less valuable part of the lumber output. Successful efforts are being made to stimulate the popularity of some of these lesser-used species, such as Engelmann's spruce, larch, lodgepole pine and white fir, and the production of these species has correspondingly increased.

Unlike the West Coast lumber manufacturers, the sawmill owners of the Western pine region have not the advantage of intercoastal shipments and easy export outlets. Their product moves to market by rail, generally over long hauls, and kiln-drying and fabrication to effect savings in freight are more common here than on the coast. Another difference is that there is no open log market in the pine area. Most of the sawmill operators have their own timber, although about half of all the timber is owned by the Government, and some of the mills depend on this source for a part of their log supply.

Kiln-drying being the almost universal practice, it is only natural that the Western pine manufacturers should have given special study to the careful and scientific seasoning of their product. It was for this end that the Western Pine Association's research laboratory was launched. Its accomplishments have been outstanding, with promise of still greater results to come. A more detailed account of the laboratory's work appears in another chapter.

As noted previously, the establishment of sawmills and production of lumber in the Western pine area was slow before 1869. But it had passed the billion mark in 1899, and climbed to over five billion feet in 1925. During the depression year of 1932 it fell back to less than

two billion, but since then has been mounting steadily and has been above six billion feet every year since 1945. Observers predict that it will level off at somewhere from four to six billion—and this volume is within the sustained-yield possibilities.

Forest Survey findings for the Western pine area (including the redwood region) show a total of 81,430,000 acres of commercial forest land, of which 45,445,000 acres are classified as saw-timber area. In this area there is a total of 537,625,000,000 feet of timber, of which 185,025,000,000 feet is ponderosa pine.

The current annual gross growth of timber in the Survey district is 1,289,000,000 cubic feet, which is almost enough to offset the total annual drain of 1,378,000,000 cubic feet. The relationship will improve, of course, as over-mature forests are harvested and replaced by young trees. At the present time 95 percent of the Western pine cut-over lands are restocking satisfactorily.

Forest fires are a serious menace in the Western pine country, as elsewhere. The lumbermen spend more than a million dollars a year for protection from fire and from insect damage. Of the natural depletion agencies, the latter has been by far the most destructive. Ponderosa pine seems to be a favored prey of an unusual variety of insects: the Western pine beetle and the mountain pine beetle, which attack the bark; several kinds of pine "engraver" beetles, which have a preference for young growth; and the pandora moth and pine butterfly, which make a specialty of eating the leaves off the trees. In 1950 there was an invasion by the spruce budworm, which is being fought by means of a gigantic aerial spraying project. Hundreds of thousands of dollars have been spent by private and governmental agencies to eliminate these pests. Oregon has a state law requiring the control of insects on private lands. The Bureau of Entomology gives technical advice. But the bugs march on.

Another source of timber loss, fortunately confined in its ravages to the white pines, is the blister rust. This destructive disease is fought with the combined energies of the lumbermen and governmental agencies, and they are making some headway.

Forestry practices as a whole are improving steadily, with more and more of a trend to selective cutting. The forests still contain a large proportion of uneven-aged, old-growth timber, much of which is overripe and stagnated in growth; but as it is removed the immature trees are released for further growth and a future crop. These ideal

conditions for selective-logging, sustained-yield practice are now recognized by an increasing number of operators, and forest management is becoming their common policy. The Western Pine Association in 1942 conducted a survey of forest practices which showed that less than two percent of the area was logged without some form of systematic cutting, and these standards have been generally maintained through the succeeding years.

Redwood

Although it constitutes less than two percent of the nation's total lumber production, there is probably no single species which has more appeal to the popular imagination than redwood. When the average man hears the name he instinctively thinks of "big trees"; the words are welded inseparably together in his mind by long association. This is a natural and proper association of ideas, but some other popular ideas about the redwoods are not so sound—that only a few of the big trees remain standing, that it is against the law to cut a redwood tree, that the redwoods are six thousand or eight thousand years old.

This confusion may arise from the fact that there are two distinct species of redwood: the *Sequoia gigantea* and the *Sequoia sempervirens*. The *gigantea* constitutes only about 20,000 acres, only a fractional part of the total stand of redwood timber; and about 90 percent is in public forests and parks. It grows in the Sierra Nevada range, at altitudes from about 4,500 to 8,000 feet, and successfully withstands both the frigid winters' deep snows and the hot dry summers. *Sempervirens*, the redwood of commerce, makes up by far the greatest part of the standing redwood timber. This is the species commonly cut into lumber, and unless otherwise specified is the species discussed here.

The *sempervirens* redwood has the distinction of being confined in its habitat to a more limited area than any other commercially developed species. Unlike the *gigantea*, which is tolerant of climatic extremes, it requires a mild, uniform climate with plenty of winter rain and summer fog. Although it will grow elsewhere in California, it finds an ideal climatic combination nowhere except in a narrow strip which closely hugs the Pacific coast. This strip, extending from near Monterey on the south to a point barely across the Oregon state line on the north, lies chiefly in the counties of Mendocino, Hum-

boldt and Del Norte—the so-called "fog belt." The riparian ribbon of redwood is mostly less than twenty miles wide and is not more than five hundred miles long. Even this stretch is not continuous, as there are several breaks where it does not grow and has never grown. The timbered area is now estimated at about one million acres, and was probably not greater than a million and a half acres when its development began about a century ago.

Among all the kinds of lumber produced in America, redwood is unique. The trees are incomparably the largest that grow anywhere on the face of the earth. Everything about them is huge. Many are twenty feet or more in diameter and rear their majestic bulk over three hundred feet toward heaven. Even their bark is thicker than any other bark—sometimes as thick as sixteen inches. The only thing small about them is their seed cone, which is hardly bigger than a nutmeg and ludicrously little for a tree of such size. Furthermore, the redwoods grow in exceptionally dense stands; and this density, coupled with the gigantic proportions of the individual trees, results in timber cruisers' reports which would be unbelievable of any other species. Single acres have been known to cut 1,500,000 feet of sawed lumber, and individual trees have been scaled to cut as much as 300,000 feet. Forty-acre tracts averaging 200,000 feet or more to the acre have been cruised, and ordinary tracts will yield as much as 75,000 feet.

Nobody knows exactly what makes the redwood trees so big. Maybe it is the ideal combination of climate and soil; maybe it is immunity to insect and disease. Whatever it is, they are the wonder of the botanical world.

The General Sherman Tree in the Sequoia National Park, of the *gigantea* species, is now recognized as the biggest tree in the world; that is, it contains more wood than any other known tree, enough to build 100 five-room houses. Its dimensions are impressive: two hundred seventy-two feet high and one hundred one and one-half feet in circumference at the bottom, large enough to permit tunneling a two-way highway through its base. The largest *Sequoia sempervirens,* according to the American Forestry Association, stands on the property of the Hammond Lumber Company in Humboldt County, California. It is three hundred eight feet high and sixty-two feet eight inches in circumference. What is said to be the tallest tree in the United States is the famous Founders Tree on Bull Creek.

This big redwood (*sempervirens*) is three hundred sixty-four feet high and, by measurements of the California State Division of Parks, is forty feet in circumference four and one-half feet from the ground.

No human being whose soul is above the level of a clod can stand by the towering trunks of such trees and feel other than a stunning emotion of awe at their giant grandeur. It is simply unbelievable. The redwood men, adapting an old fish story, tell of a logging superintendent from Georgia who visited one of the California operations and felt overwhelmed. As the gaping "Cracker" gazed in wonder at a supertractor dragging in a redwood log twenty feet long and sixteen feet across the butt, he muttered incredulously, "The man who cut that log is a damned liar!"

The redwoods are not only big, they are old—not so old as some people think, but probably older than any other living thing at that —and they carry all the dignity and impressiveness that come only with great age. How old are the redwood trees? Foresters and botanists hesitate to attempt an exact answer. They have not the temerity of one resident along the Redwood Highway who, when asked the age of a big tree across from his home, answered promptly, "It's three thousand and seventeen years old." Asked how he could be so sure of the exact number of years, he replied, "Well, I've lived here seventeen years and they told me it was three thousand years old when I moved in." The General Sherman is now generally estimated to be about three thousand five hundred years old, although claims have been made that it is nearer four thousand—and, on the other hand, some conservative estimators have placed it around three thousand. The oldest *sempervirens* ever authentically dated was a little more than two thousand two hundred years old.

Redwood lumber is a serviceable and valuable material, widely used in the United States and in foreign countries. It is a so-called "specialty" wood, one of the durable-woods group, together with cypress and the cedars. The Franciscan missionaries, as long ago as 1776, used it in the construction of their mission houses in San Francisco and San Jose, and after more than a hundred and fifty years of service the posts and beams are still sound. Its durability recommends it for many structural purposes, such as highway bridges, trestles and mill roofs, as well as for siding for houses, stadium seating and other outdoor uses. It is favored also for tanks and vats, because of its resistance to most chemicals and its property of imparting no noticeable

taste to liquids and solids. In California it is commonly used for wine vats, and it has also been widely utilized for industrial water tanks and for constructing many miles of water pipe. For the manufacture of shingles, its peculiar quality of fire resistance and straight grain make it an especially good wood. Aside from its manufacture into sawed products like lumber, redwood finds widespread popularity in the field of "split" products: crossties; hand-rived shingles, called "shakes"; "grapestakes," the sticks used for the vines to run on in the California vineyards; fence posts, etc.

Like the trees themselves, the redwood sawmills are big affairs. The larger mills cut 500,000 or 600,000 feet a day. Storage sheds cover ten or twelve acres under a single roof. Planing-mill and kiln-drying facilities are extensive. Nothing is spared that will contribute to the quality of the finished product.

The redwood lumber manufacturers have not only taken an active and prideful interest in improving the quality of their lumber by the pursuit of the most advanced manufacturing methods, but they have also carried on extensive studies to develop by-products and turn waste to account. A use is found for even the wartlike burls which occasionally grow on the trunks. Local manufacturers of novelties make vases, ash trays, plates and similar objects or ornamental woodwork out of them.

Especially interesting is the work that has been done to utilize the bark. This extra-thick—and extra-tough—fibrous bark has always been a nightmare to the redwood sawmill men. Its peculiar stringy quality quickly clogs up the gullets of their saws and necessitates frequent stoppages to change them. This slows down production and also involves a heavy investment in big band saws; and with saws costing from $1,000 to $1,750 a pair and skilled sawmill labor commanding $2.00 or more per hour, it runs into money. Many operators meet the difficulty by peeling the bark from logs in the woods before bringing them to the sawmill.

One big redwood manufacturer, the Pacific Lumber Company at Scotia, California, has worked out an ingenious solution of the bark problem which kills two birds with one stone. It brings the logs, bark and all, to the millpond and there, in a separate plant, strips them of their bark. The bark is carefully salvaged and in an adjacent subsidiary plant is dried and shredded. It is now utilized largely as insulation, for which it is well suited, but interesting experiments

with the fiber have been made also in the textile field. Here the fibrous quality which gives sawyers headaches proves valuable. Experimental cloth has been woven of a combination of wool and redwood fiber which textile experts regard as having great possibilities. Felt hats too can be made of it.

A complicating factor is introduced into the redwood business by the fact that the trees occupy a dual role. They not only constitute a useful natural resource, the raw material of an important branch of a great industry, but they are also a natural wonder of the world, a scenic beauty which gives the public an emotional claim on them altogether aside from their utilitarian value. Be it said to the credit of the private owners of the redwood timberlands that they, voluntarily and without any form of compulsion or coercion, have recognized the obligation resting on them to permit the setting aside of typical tracts as perpetual reservations for the enjoyment and edification of the general public. Nearly all the Sierra or *gigantea* type is now in National Parks, and the timberland owners, acting in co-operation with the California State Park Division and the Save the Redwoods League, have selected some of the very choicest and most accessible groves of the *sempervirens*, aggregating more than 60,000 acres, for state parks. All these reservations are close to main-traveled roads; some of them are strips stretching mile after mile on both sides of the Redwood Highway and give the tourist an impressive view of the big trees in their native habitat. The most extensive park unit is at Dyerville and includes the famous Bull Creek flat. This tract of about 13,000 acres is regarded as the place where redwood reaches the acme of perfection.

Park representatives and the industry have agreed that the redwood region may properly be divided into two use classes: one for park purposes in which the timber is left in its virgin condition, and the other for commercial operation. The trees in the commercially operated forests are not on the average so big as the specimens in the show places. Occasionally a tree is cut for lumber which measures as much as sixteen feet or more in diameter at the butt, but logs of such giant size are uncommon, and when they are cut they are too big even for the big redwood sawmills. Such monsters are split—with dynamite!—into halves which can be handled conveniently. The ordinary run of redwood cut into logs will average four to eight feet in diameter, with some few ten to fourteen feet.

Most of the commercially operated timber is in the back country where the sightseeing tourist never penetrates. Even in the commercial operations, however, its scenic value is not entirely sacrificed. During recent years the lumber companies have begun programs of selective logging which will preserve the aesthetic integrity of the commercial lands also. This practice, still comparatively new, is rapidly spreading. It assures the saving of immature trees for future growth and a source of seed for natural reforestation.

So there will always be redwood trees. There will always be hand-picked reservations of exceptional aesthetic and inspirational appeal, forever dedicated to public use in all the rugged beauty of their primeval condition. Also, unless the present trend is reversed, there will always be commercial redwood timber, maintained by its owners in a state of continuous production, assuring plenty of lumber for present and future needs.

The first development of the redwood timber began about the middle of the nineteenth century, when the gold seekers were pouring into California and there was an insatiable demand for building material in the mushroom growth of San Francisco. Those were the days of "inexhaustible" timber. The pioneer lumbermen tore into the convenient near-by forests with the currently crude logging methods which gave no consideration to the preservation of young timber, and nobody thought of making any effort to keep fires out of the woods.

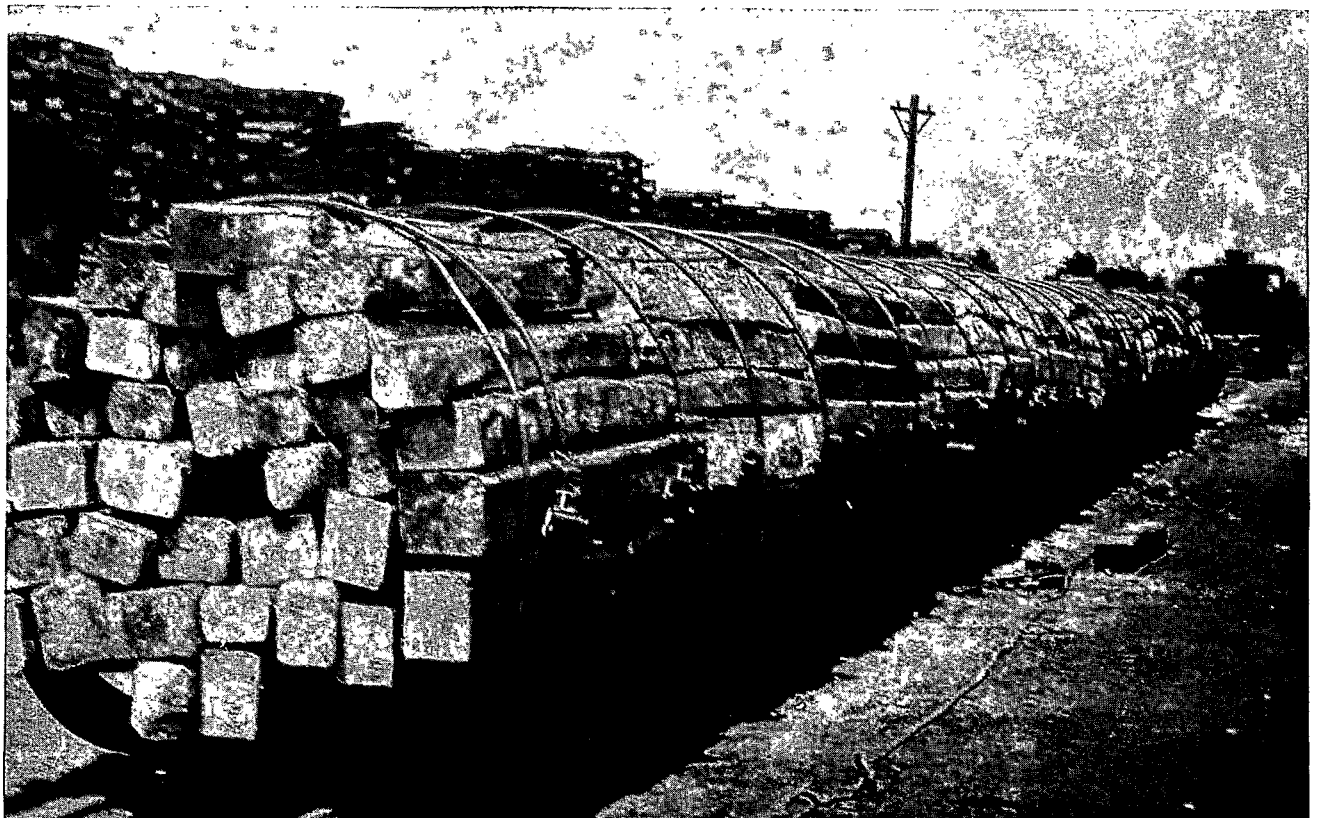
Eventually, however, the men who had the greatest stake in the preservation of supply—the lumbermen who had their money invested in timberlands—woke up to the fact that "sustained yield" was not a meaningless phrase. Aside from selective logging three different methods of perpetuating the forest supply were considered and tried: planting, reseeding and leaving seed trees.

The redwood industry, on an organized basis, gave planting a thorough trial during an eight-year period from 1922 to 1930. The experiment cost them $250,000, and convinced them that this method of reforestation was not practical in the redwood country, to the best of current knowledge. Seeding was tried to a limited extent in the early twenties and again in the middle thirties, but broadcast seeding also was barren of any promise of practical results. Experiments in seeding practices are continuing, but redwood operators now feel that the most immediately promising course is a program of selective log-



Photo by Rognon Studio, Westwood, California. Courtesy The Red River Lumber Co.

ELECTRIC LOGGING RAILROAD



CROSS-TIES, NEEDED FOR MAINTENANCE OF ALL RAILROADS, ARE BEING PULLED FROM A CYLINDER AFTER A CREOSOTING TREATMENT

ging: harvesting the mature timber and leaving the immature trees (up to four feet in diameter in some cases) and an ample supply of seed trees. About half the present redwood production is logged on this basis. In 1950 a Tree Farm program was launched by a group of the leading redwood operators, with 108,000 acres of private redwood forest land already certified as Tree Farms, thus providing substantial evidence that the principles of conservative forest management can be applied in the redwoods as well as in the smaller timber.

From the purely silvicultural standpoint redwood is ideally adapted to selective logging. The trees do not grow in masses of even age and even size, but the typical redwood forest includes an irregular mixture of all ages and sizes, from seedlings and stump sprouts up to mature trees over ten feet in diameter. If the big, mature trees can be harvested with a minimum of damage to the remaining stand, smaller and younger trees will immediately begin to grow at a more rapid rate. Succeeding annual crops of seeds from the seed trees will take root and develop new annual supplies of seedlings.

Then, too, the volume of the regrowth is accelerated by another unique quality of the redwood—its capacity to reproduce itself by sprouting from the stumps. Throughout the district today stumps left by the pioneer loggers may be seen—a redwood stump rots very slowly—surrounded by three or four or even six or eight thrifty young trees, some of them two feet or more in diameter. The sprouts, added to the seedlings, added to the growth of the older trees left in the first cut, provide a steadily increasing volume of timber on the cutover land. So the operator may return at periodic intervals and harvest successive crops of mature trees on a basis which is at least theoretically profitable.

When first contemplated, selective logging was difficult, if not impossible, because of the nature of the equipment—the only equipment available—by which the logging operation was carried on. All operators used the heavy steam donkey engines with either the high-lead or the slack-line method of hauling in the logs to the loading point, and this system was notoriously destructive of young timber. It was not until the advent of the "track-laying" tractor that selective logging became really feasible. Now, especially since the development of the Diesel tractor, it is common.

The mechanical problem was not the only one, however. Here, as elsewhere, fire constituted a conspicuous obstacle to perpetuating

the supply. The improvement of fire-fighting facilities may now bring under quick control the fires which once were permitted to ravage the forests unopposed, destroying the young growth almost as fast as seeds could germinate. Fortunately, too, redwood is exceptionally resistant to fire damage when the trees are mature, and this to some extent simplifies the disposal of slash—the inflammable offal of logging—by burning. Nevertheless getting rid of slash remains the chief difficulty in redwood forestry.

"What do you do in the way of forest conservation?" a visitor from the South asked a logging superintendent on a redwood "show" in northern California.

"Just two things," he said. "We try to keep the fire out of the woods, and we don't cut any of the small trees. We cut to a strict minimum-diameter limit."

"What is the minimum?" the visitor asked, thinking instinctively of some of the peckerwood loggers in the South who will cut any tree that will make a two-by-four.

"We don't cut any small tree less than thirty-six inches," the redwood logger replied, and the visitor hastily agreed that it was probably best to leave these three-foot saplings and let them grow into man-size trees.

In round figures the existing supply of old-growth redwood timber is estimated by the industry to be close to fifty billion board feet,* growing on 931,000 acres—an average of about 50,000 feet to the acre, which for ordinary kinds of timber would be considered an astonishingly heavy growth. For purposes of computation, and again using round figures, the annual removal, for lumber and other products, is about a half-billion feet. If the forest growth were static, the existing supply would obviously last another hundred years. As a matter of fact, the mature trees have indeed about reached the limit of their growth; some stumps show growth rings so close together during the past hundred years as to be almost indistinguishable except with a microscope. But the young growth is not static; it will grow rapidly if given a chance such as removal of the mature timber affords. Studies of cutover areas indicate that a new growth of 1,000 feet per acre per year is easily attainable on lands selectively logged, and that growths exceeding 3,000 feet per acre have been measured on some of the best lands.

* The Forest Service estimates the stand at 38 billion feet.

A new factor has been introduced into the redwood situation within recent years, due to the utilization of the other species (such as Douglas fir and white fir) which grow intermingled in the redwood timber stands. As recently as ten years ago these other species were not economically marketable, but nowadays as much as 10 percent to 20 percent of some of the redwood mills' production is made up of these woods. Naturally, this is serving to make the supply of old-growth redwood timber last longer and improves the possibilities for perpetual production at a high level.

Professor Emanuel Fritz of the University of California, who has made a lifetime study of the redwood forests and probably knows more about them than any other living man, figures that there is already on the old cutover territory an annual growth of about 87,500,000 board feet. As to the remaining old-growth forests, and the prospect for their regeneration and perpetuation, Professor Fritz figures this way:

Suppose we disregard all of the past cutting and consider only what is left of the virgin redwood forest. At the expected rate of logging, 500,000,000 board feet per year, it would appear that we are overcutting the growth by just that amount during the first year, because the virgin timber itself is believed to make no accretion in volume. In the second year we will appear to have overcut the growth by 1,000,000,000 board feet, less the growth on the area cut the previous year. If logging and growth on new cutover lands are projected forward 50 years it becomes less and less apparent that the forest area is being overcut. The cut in the fiftieth year will still be, for the purpose of this exposition, 500,000,000 board feet, but there would be accumulated by the time 10,000 acres $\times$ 50 years or 500,000 acres of cutover land (actually it will more likely somewhat exceed 500,000 acres because some lighter stands will have been cut). The annual growth on such an area of selectively logged cutover land should produce 500,000,000 board feet per year. This is equal to the annual cut. Thus, so far as the 500,000 acres are concerned, growth and depletion are balanced. But at the end of the 50 years there still would be another 500,000 acres of virgin redwood in which there has been no logging. Hence for the region as a whole current depletion is far below regional growth capacity.

Professor Fritz is careful to point out that he has used round numbers and that selective logging must be rapidly improved and generally applied to realize this ideal setup. He admits that his assumed condition is open to the criticism that all the cutover lands are not

now being left in such shape as to produce the maximum of regrowth per year. He concludes, nevertheless, that despite the lack of attainment as yet of the ideal procedure, the steady progress and the large reserve of virgin timber are great enough not only to absorb the slack due to delay in getting the selective logging program perfected but also to permit some production expansion. In fact, he feels that—with the constant improvement in logging and sawmilling practices and the increased growth on cutover lands—it seems safe to predict, within the foreseeable future, an annual production of a billion feet of redwood on a sustained-yield basis.

Chapter VI

LUMBERING IN THE SOUTH

WHEN "the South" is referred to in the lumber business it is necessary to make sure there is common understanding of how much territory is embraced by the term. The Department of Agriculture, of which the Forest Service is a division, has its own ideas as to geographical designations, and they vary from time to time. Other governmental departments have different ideas. The War Production Board in one of its rulings included Texas as a "Western" state. In some official groupings, Tennessee is listed as a "Central" state. Within the hardwood industry the word "Southern" takes on a special trade connotation quite distinct from its geographical meaning.

Botanically, the trees growing in the Appalachian region are of the "Northern forest" type; but geographically that area lies almost entirely south of the Mason and Dixon line and in a broad territorial sense should be considered as a part of the South, as compared with the West or the Northeast. In the lumber trade, however, the Appalachian region is considered as something separate and apart from other sections, even other parts of the South which produce the same species of trees. In wartime ceiling prices and other regulations there was a distinct line of cleavage between the "Appalachian" and "Southern" lumber, even though the Appalachian territory includes parts of such indisputably Southern states as Tennessee, Virginia, North Carolina and even the northernmost parts of South Carolina and Georgia. When an Appalachian lumberman speaks of "Southern" oak or poplar, he is not talking about the oak or poplar produced in that section of the South lying within the Appalachian region, but is referring to lumber manufactured in the lowland South. Lumber cut in Memphis, for instance, is "Southern" and lumber cut in Knoxville is "Appalachian," although in both instances it is cut in Tennessee, a Southern state. It is a little confusing to the layman, but the lumbermen understand it.

Hereinafter when the words "the South" are used the territory is meant which lies south of the Mason and Dixon line—the territory

which officially constituted the late Confederate States of America, than which there could be nothing more Southern.

The South has the distinction, as a region, of having been a continuous major source of lumber production longer than any other section of the country. Also, it has produced a total volume of lumber greater than any other section. Furthermore, outstanding among all the producing regions, it is successfully solving the problem of bridging the difficult transition period between the liquidation of old-growth timber and the establishment of sustained-yield practices, without appreciable diminution in total production.

The Northeast and the Lake States had their old-growth timber—especially the softwoods—just about liquidated before it was felt necessary to take thought of the morrow. The West is still cutting largely in old-growth timber; and, although it is encouraging and protecting the second growth, is not yet depending on it for a log supply. In the South, on the other hand, most of the old growth has been harvested, and a very large part of the current lumber production is from second growth. These trees have grown up to commercial size during the lifetime of the men who are harvesting them—and they make good lumber.

The South, therefore, constitutes a large-scale proving ground of the feasibility of sustained-yield lumbering. Not all the operators, to be sure, are on sustained yield, but the practice is sufficiently prevalent and has had enough actual trial to indicate that it is profitable and to furnish foundation for expecting that lumber production, especially in pine, may be maintained at about its current level for an indefinite period. Statistics of the United States Forest Service show that of the total privately owned commercial forest areas in the South 85.8 percent are in productive condition—yielding crops of timber for future harvesting.

As matters stand, 44 percent of the commercial forest area of the country is in the South, and about 22 percent of all the country's supply of saw timber is there. Of the present annual effective growth, 21,016,000,000 feet is in the South, out of the nation's total of 35,-301,000,000. Of the total amount of saw timber used in the United States every year, nearly one-half comes from the South. More than 45 percent of Southern land is covered with forests. The South, naturally enough, is distinctly forest-conscious.

Lumbering and logging here—except in the Appalachian region—

does not have the picturesque and dramatic qualities of the West and North. There are no lumberjacks in plaid shirts and hobnailed shoes, performing herculean feats, speaking their own vernacular, and living in the isolated camps. Lumber and logging operations in the Deep South are largely manned by Negro labor, except in the skilled employments. The workers live in their homes or boardinghouses and go to and from their work each day, taking their lunch with them—so there are no bunkhouses or cookhouses. The workmen have developed no jargon special to their trade; they use commonplace words to describe what they are doing—and they never heard of Paul Bunyan.

The larger operators own their own timber, although most of them augment their supply by buying logs from farmers or other forest owners. Some sawmills, especially in hardwoods, own no timber but depend on such outside sources entirely. There are, however, no such open log markets as there are in the Pacific Northwest, and no large logging operators who conduct their business in the expectation of selling their logs on such a market.

A distinguishing feature of the manufacturing industry here is the remarkable prevalence of small portable mills. No one of them makes much lumber, but in the aggregate they account for considerable production. Some of them are efficient, but many turn out a poorly manufactured product—lumber that is not really merchantable until it has been remanufactured and seasoned by some concentration yard. Most of them have no sufficient financial stake in the industry to be interested in its future. They do not belong to associations, and often proceed in a loose and irresponsible fashion. The peckerwood millman is the problem child of the Southern lumber industry.

Southern Pine

Southern pine has the distinction of providing a larger proportion of the country's total lumber production than any other species. It has occupied this position of precedence every year from 1899 through 1948, with the exception of 1931. From year to year the volume of pine yield, along with all other lumber production, has fluctuated with the demand, but for the past fifty years or more it has been supplying about one-third of all the lumber cut. In 1939 it was 31 percent, in 1929 it was 31.5 percent, in 1919, 37.8 percent, and so on.

Since 1869, 625 billion board feet of Southern pine lumber has been manufactured and consumed, about a third of the country's all-time total lumber production.

How the annual volume has varied with the strength of the demand may be seen by a brief survey. In 1899 the output of the pine mills was a little short of 10 billion feet. Then from 1900 to 1908 it averaged about 11 billion feet per year. It went up to more than 16 billion in 1909, which was the peak year for all lumber production. From 1910 to 1919 it averaged 14 billion feet, and between 11 and 12 billion per year during the next decade. During the depression years along with all other species it fell off about 50 percent. It came up to 7 billion feet a year from 1936 to 1939; then rose to above 10 billion feet annually in 1940 and 1941, and above 11 billion in 1942. During the last five years it has averaged more than nine billion feet per year. For the past few decades the production has leveled off at a rate which is sufficient to supply the demand but which is little, if any, in excess of the annual growth of the timber, and it appears that the Southern pine industry can be maintained on about this basis for an indefinite time. The United States Department of Commerce, in its publication *American Southern Pine* says: "Today's forest situation in the South, particularly the trend toward intelligent forestry practices, indicates that an adequate supply of Southern pine lumber will be available for the needs of future generations." With a total stand of nearly 200 billion board feet of saw timber, and the annual cut already almost in balance with the growth, this seems a safe prediction.

Southern pine's history extends back over three hundred years. The earliest colonists along the Atlantic seaboard recognized its unusual versatility and strength—it is the strongest of all the softwoods —and the industry may be said to have had its birth in the tidewater sections of Virginia and North Carolina, where John Smith and those who followed him found the pine tree a very valuable help in getting themselves established. As the country grew and the settlements multiplied, the development of pine timber extended down the South Atlantic coast and on across to the Gulf coast. According to tradition, the first steam-powered sawmill in the South, cutting yellow pine, was built at New Orleans in 1803; but the construction of the mill was so strongly resented by the men who made their living by pitsawing that a mob of them destroyed it—a not unusual sort of

disturbance in days when the machine age was first making itself felt, to the detriment of the handcraft workers. These early mills along the seaboard nibbled away at the timber sufficiently to supply their own local needs and also to ship some of it in schooners to adjacent ports or in the export trade—where it was, and still is, called "pitch pine." But the industry, if such it could be called, was distinctly a small affair.

It was not until after the War Between the States that active exploitation of Southern pine timber began and the Southern pine business as we know it showed the first signs of becoming a prominent factor in the country's industrial life. Northern men had a hand in this, men who had come to the South with the Union armies during the war, or who arrived during the Reconstruction period, not as "carpetbaggers" but as welcome, constructive investors. A good deal of the postwar activity was on the part of native Southerners who found themselves impoverished and saw an opportunity to help rebuild their country and at the same time rehabilitate themselves economically by turning some of the plentiful and cheap timber into lumber. Miss Scarlett O'Hara, readers of *Gone With the Wind* will recall, started a sawmill near Atlanta when the war was over, and what she did and why she did it were fairly typical of numbers of the more enterprising and resourceful Southerners.

There was, for instance, W. W. Wadsworth of Alabama. He fought four years in the Confederate army and at the close of the war returned to Alabama where, for want of anything better to do, he went to work in a lumber yard. Within twenty years he had become an outstanding figure in the infant Southern industry. He owned mills and timber, was president of the Alabama Yellow Pine Lumber Association; and his standing among his fellows was so secure that a contemporary editor commented admiringly that the fearless Mr. Wadsworth had been known to ride to the polls in a buggy with a Republican without tarnishing his reputation or his popularity.

A similar experience was that of A. C. Danner. In 1865 he returned to Mobile, after four years of service in the Confederate army, in the financial condition typical of the ex-Confederates of that time —penniless. As a means of livelihood he started cutting and selling cordwood; from cordwood he turned to selling lumber; soon he was able to start a sawmill. Within a few years he was head of a big lumber business, president of the leading bank in Mobile, and hailed as

"the leading lumberman of the South." His timber holdings grew to 50,000 acres in a short while, and his success was so marked that the Mobile and Ohio Railroad made a deal with him to cut the timber from their 750,000 acres of land along their road in Alabama and Mississippi. In 1884 he furnished two million feet of pitch-pine lumber and timbers which were used to build the Antwerp Exposition in Belgium.

D. M. Wadley, a native of Tennessee, operated the Confederate States' powder plant at Marshall, Texas, during the War Between the States, and after the war started a sawmill and planing mill at Arkadelphia, Arkansas, in connection with the three Allen brothers of that town. The Wadley and Allen families continued active in the Southern lumber business for generations, and William D. Wadley, grandson of the powdermaker, emigrated to California about the turn of the century and became prominent in the redwood trade.

At first there was ample local demand for all the lumber cut by such post-bellum mills, but as this demand was satisfied and as the local railroad lines were linked up into through trunk systems—and changed to standard gauge—the markets north of the Ohio River began to be invaded. In 1875 there was a fairly active sale for Southern pine in that northern territory, although it had a hard time competing with the favored white pine.

Along about that time, the white pine around the Great Lakes began to run low, and the opulent operators there started looking for new forests to conquer. Most of them had not thought before of Southern pine—"yellow pine," it was called then—as a material of any great commercial consequence. They laughed at the very idea of using yellow pine in place of white pine, but when their white pine began to show signs of exhaustion they stopped laughing and by 1880 they had decided to look into the timber resources of the almost unknown South.

"Cruisers" were sent into the Southern states to examine the timber and find out about its supply, its price and operating conditions. They returned, like the spies sent by Moses to inspect the timber in the land of Canaan, with glowing stories. There were boundless forests of yellow pine, stretching for miles and miles. The ground was mostly level, and logging would be easy. There was plenty of cheap labor. Best of all, the timber was cheap; there were thousands of square miles of it that could be bought from the government for

$1.25 an acre and it would cut from 6,000 to 12,000 feet to the acre. Billions of feet were available at ten cents, or even five cents a thousand feet. It sounded like a lumberman's bonanza, and the lumbermen and timber speculators from the North came down and invested heavily.

Development of the Southern pine lands did not come as a single organized movement. There were regional waves of activity. Georgia, having the advantage of convenient coastwise transportation through Savannah, Brunswick and Darién to the markets of the populous East, as well as offshore, was one of the first Southern states to attract the eye of the Eastern lumberman and blossom out into big production.

Such men as Greenleaf Johnson and E. L. Tunis, pioneer lumbermen of Baltimore, introduced Southern pine into the markets of the East soon after the War Between the States to supplant the rapidly fading white pine. These operators' timber holdings were mostly in North Carolina, and by reason of this fact the pine from Virginia and both North and South Carolina came to be known in the trade as "North Carolina pine."

William E. Dodge, a New York capitalist, went to Georgia in 1875 and invested in a tract of 300,000 acres of pine timberland in Dodge, Telfair and Montgomery counties, organizing for its development the Georgia Land and Lumber Company. Mr. Dodge built a sawmill on St. Simon's Island, near Brunswick, with a daily capacity of 140,000 feet. This mill was a nine days' wonder, and did a very large domestic and export business for a number of years. The timber in the up-country was logged to the Altamaha River, down which it was rafted to booms twenty miles above the river's mouth at Darien, and from these booms the logs were hauled by steam tugs to the sawmills on the inner side of St. Simon's. All the shipments from the mill were by sailing vessels, as many as twelve schooners being tied up at the mill's loading docks at one time. Cargoes went export to South America and other markets, and coastwise to New York, Philadelphia and New England ports.

By 1885 the virtues of Southern pine had reached such a point of recognition in the East that the New York *Tribune* in a laudatory article said: "In places where wooden flooring or trimmings undergo severe or constant use, the valuable Southern yellow pine has become almost indispensable. In ship work its durability has long been ac-

knowledged, but it is only within a few years that its usefulness for house work has been appreciated. . . . No wooden floor that is used bare is superior to narrow strips of Georgia yellow pine. A well-laid surface of the wood improves with age and friction. . . . The supply of this timber seems exhaustless. A large fleet of schooners and other craft is devoted exclusively to its transportation from Virginia, North Carolina, South Carolina and Florida. The latter state is noted for the long boards that are cut from its trees."

This reference to its popularity "in ship work" was a point well taken, for in 1884 Southern yellow pine had gained such a favorable position in the shipbuilding trade that the official reports of the shipyards in Maine showed that in building thirty-eight vessels, aggregating 41,396 tons, they used 13 million feet of Southern pine and only 2 million feet of Northern pine and 4 million feet of white oak.

When the sawmill men from the Lake States moved southward there were two separate directions of movement: some established themselves east of the Mississippi River, in Alabama and Mississippi, in a position to cater to the markets of the Central States; others bought timber west of the river—first in Missouri, then on down through Arkansas, Louisiana and Texas—with the idea of selling their output to the prairie states. By 1883 there were enough pine sawmill operators in Missouri and Arkansas to feel the need for organizing a lumber-trade association, and about the same time a similar organization was formed on the South Atlantic Coast—the first record of cooperative effort among the lumbermen of the South.

The invasion of the prairie states markets by Southern pine in the late eighties and early nineties led to an investigation of the South's timber resources by two brothers, then engaged in the retail lumber trade, who later became prominent in the Southern pine manufacturing trade. Samuel H. and Robert Fullerton were operating a string of line yards in Kansas which had been started in 1873, and they were among the first dealers in that territory to realize the merits of the Southern wood. Recognizing its future, they invested in a sawmill and timber in Louisiana in 1894, and later extended their operations to Arkansas, where the family interests are still actively engaged in sustained-yield operation of the timberlands acquired by the Fullertons nearly fifty years ago.

These west-of-the-river pioneers in the Southern pine field had a tendency to build up chains of sawmills, backed by extensive timber

holdings. "There were giants in those days"—William Buchanan and John Henry Kirby and R. A. Long and Captain J. B. White and the Frosts and the Dierks and Pickering interests, to name but a few. Each of these had a string of from six to a dozen big mills. A few of them now have cut out and got out. R. A. Long moved on to the West Coast to become a big-scale fir operator. A number of others —such as the Kirby, Frost and White interests—are still operating in the South on a big scale, and on a sustained-yield basis.

By 1890 the development of Southern timber was well under way, and it was stimulated greatly by favorable publicity when a number of the buildings at the Chicago World's Fair in 1893 were erected of Southern pine. By 1900 it was the dominant species in the softwood market—and so it has remained ever since.

The lumber trade knows two varieties of Southern pine: longleaf and shortleaf. The longleaf is a separate botanical species (*Pinus palustris*), whereas the general name of shortleaf is applied in the industry to all the kinds of Southern pine that are not longleaf. Included in the lumber sold as shortleaf is not only the species which the botanists call by that name (*Pinus echinata*) but also the closely related loblolly (*Pinus taeda*), and, to a small extent, spruce pine (*Pinus glabra*), pond pine (*Pinus serotina*), sand pine (*Pinus clausa*) and Virginia pine (*Pinus virginiana*). There is an intermediate species called slash pine (*Pinus caribaea*) which has some of the characteristics of the longleaf tree.

Longleaf pine, for many years regarded as the foremost structural softwood, originally grew in a broad belt—about one hundred and fifty miles wide—stretching down the Atlantic Coast from Virginia to Florida and across the Gulf states to eastern Texas. Today this old-growth longleaf has been, to a large extent, harvested and used, but there are still some very large stands of it remaining in the hands of sawmill operators. It gets its name from the fact that its leaves or needles are longer than those of other pine species, running from nine to twelve inches usually. Sometimes—especially in young trees—the leaves are as long as eighteen inches. In the longleaf section of the South the natives frequently break off the tops of these young trees and use them as nature-made brooms. In general, longleaf pine lumber commands a higher price than shortleaf, and is preferred to shortleaf for structural purposes. For interior finish, where softness and lightness are valuable qualities, the shortleaf is thought better.

Slash pine, sometimes called Cuban pine, has some of the characteristics of longleaf, and in recent years has sprung up over large cutover areas where the longleaf formerly grew. It is confined almost entirely to the coast, and is seldom found more than one hundred miles inland. It has the merit of growing rapidly, especially when young, and much of the replanting of seedlings in cutover land has been in this species. It is coming to be looked on as one of the most valuable varieties of Southern pine. It shares with longleaf the valuable quality of being able to produce naval stores.

The various kindred members of the *Pinus* family which are commercially grouped as "shortleaf" grow pretty much all over the South, extending up even into the mountainous country. The most prolific is the loblolly, also called old-field pine, the latter name derived from its propensity to invade and take over old, abandoned fields. The upheaval in the South's economic conditions after the War Between the States and the emancipation of the slaves caused many plantations to be abandoned for want of labor or financial resources. A good deal of the commercial timber from which Southern pine sawmills derive their log supply is growing in the abandoned cotton fields, the old furrows still being plainly visible. A count of the annular rings in the end of logs cut from this timber will almost invariably date the trees as having started their growth in the late sixties.

The shortleaf-pine lumber is used mostly for construction purposes—interior finish, sheathing, siding, flooring, ceiling, etc.—but much of it is also used for boxes, crates and slack cooperage, and for other industrial purposes.

About 15 percent of the total annual production of Southern pine goes into timbers—sawed material four by five inches or more in size—for which its strength admirably suits it. The remaining 85 percent is what is known as yard and shed stock, although much of it does not go to the retail yards but is used in railroad-car building and otherwise industrially. Yard and shed stock includes boards, dimension, flooring, shiplap, siding, ceiling and other miscellaneous items.

An outstanding asset of Southern pine is the ease with which the sapwood lends itself to treatment with wood preservatives. Because the cell structure permits the injection of the preservative chemicals without destroying the fiber, it is a favored species for crossties and piling, and much of the mills' output finds its way into such channels.

Southern pine lumber is shipped to all the states east of the Rocky Mountains in considerable quantities, but just about half is consumed south of the Ohio River, in the producing territory. Texas takes more pine lumber than any other state in the Union—about 15 percent of the annual cut. The other states leading in consumption are Ohio, Illinois, Pennsylvania, Indiana, Michigan, New York, Missouri, Louisiana and Oklahoma. States like Iowa, Kansas and Nebraska, which in the early days of their settlement derived most of their lumber supply from the South, now take only a relatively insignificant part of the output.

Through the long years of the industry's existence, export trade has been an important factor. Historically, its first exportation from the shores of this continent was that shipload of pine clapboards sent from Jamestown to England in 1608. Ever since there has been something of an export Southern pine business, although it was of a naturally restricted nature in its earliest days.

There is written record of a pine sawmill at Savannah in 1744 operated by the firm of Harris and Habersham, which in 1749 is known to have shipped a cargo to London. With ports like Darien, Savannah and Brunswick at the mouths of the rivers giving access to the interior, an active export lumber trade steadily grew up in Georgia. By 1841 it had reached a volume in excess of 14 million feet. This had grown to 50 million feet by 1861, and although it was stopped by the Civil War it flourished again after 1865. The export trade reached its peak in 1906, when 245 million feet were shipped through Savannah.

What happened at the Georgia seaports was duplicated at points all along the South Atlantic and Gulf coasts. Through the years a steady movement of Southern pine lumber has flowed through these ports to the countries of the world. The longleaf pine made a name for itself in the shipyards of Europe more than a century ago and has remained a favorite abroad. As recently as 1938, the London County Council enacted legislation permitting a 50 percent higher load-carrying strength for longleaf than for any European softwood used for framing.

Export trade has been simplified by the fact that the timber supply is easily accessible to so many good seaports. From them all in normal times Southern pine—"pitch pine"—has been going to foreign lands. In Europe, in South America, in Africa and "the Islands,"

it has been used for many years in the form of piling and timbers and sawed lumber, for dock construction, for shipbuilding, for construction, for railroad cars and crossties and bridges, in mining and even for making furniture.

During World War II the exports of all lumber (including Southern pine) declined precipitately. Southern pine exports fell off to only 10 percent to 15 percent of the peak export levels of 1929, and since the war 1947 is the only year in which total exports have exceeded a billion feet.

The Southern pine region went through its era of destructive skidder logging, followed by disregarded fires which swept through the cutover lands killing the young growth and scorching away the young seedlings. That era, however, as indicative of general practice, lies so far in the past that it is seldom remembered now except when some alarmist newspaper or magazine writer harks back to it for propaganda purposes. In spite of the careless early logging and long years of uncontrolled fires, the native trees valiantly fought their way back and produced a new crop. This made operators stop and think. If a fresh crop could be produced by Nature in the face of such difficulties, what might be done if the growth of new trees were encouraged by selective logging and fire control?

Logging methods have completely changed during the past thirty years. Today a steam skidder is almost a curiosity in the South. The crawler-type tractor and motor truck are now mainstays. Fire is still a menace, and a serious one, but greater efforts are being made to prevent and control fires in the woods. There are more and more lookout towers, better and better organized forest fire-fighting systems.

The Southern operators are the victims of a peculiarly misguided local custom of periodic burning of the woods by the natives. Educational and punitive measures are aimed at correcting this evil; and at the same time large sums are spent in systematic fire-control work. Here as elsewhere fire is still the chief foe of sustained-yield logging, but progress in its control is constant. Progress has been made also in solving the problem of taxation; uncertainty on this score has been one of the main hazards of the forest farmer. Furthermore, the market value of standing timber is now at a level which makes forestry financially more attractive than it was in the days when timber could be bought for a song.

Some question as to the adequacy of the Southern pine timber

supply has been created by the advent of so many new paper mills in the South during recent years. Unquestionably there has been some clear-cutting of small tracts of pine timber by independent pulpwood contractors, and this has aroused well-justified protest. The large paper and pulp manufacturers, however, seem to be genuinely concerned about the maintenance of supply and most of them not only practice sustained-yield cutting on their own extensive holdings but also urge and encourage it with those from whom they buy pulpwood. The paper mills have a big investment in plant and equipment. It is to their material interest to insure the perpetuation of supply, and they are trying to do so.

Then too some success attends an endeavor to integrate the paper and lumber activities in such a way that the saw-log-size timber from the paper companies' lands may go to the sawmills and the thinnings and other cordwood material from the lumber companies' holdings may go to the paper mills. In this way the maximum utilization of the available supply may be realized.

Hardwoods

The first recorded use of the hardwood resources of the South was during the earliest days of our history when the live oak was utilized in shipbuilding. The famous frigate *Constitution*, launched in 1797, was built of live-oak timbers and framing cut by a sawmill on Saint Simon's Island near Savannah, a mill run by tidewater power—a sort of miniature Passamaquoddy. The waters of the flood tide were impounded as they came in, and as they went out they turned the wheel. As the years went by other sawmills sprang up in the hardwood regions of the South, but they were mostly small affairs, serving the local trade, and even all together they did not constitute what might be called an industry.

The earliest pioneers operated quietly—almost furtively—for there was considerable rivalry in the location of new timber supplies. In the early seventies, after decades of hardwood operations in the Central States, timber scouts began to smell out the native black walnut trees in Tennessee and Kentucky. Going into the country on horseback, they bought and branded selected individual trees, which were later sawed into lumber on mills installed for the purpose. Much of this walnut went into the manufacture of sewing machines, which

were enjoying their first great wave of popularity, some of the lumber was made into furniture, and some was exported to Europe. A little later other scouts drifted in to buy up the best of the big yellow poplar trees; then came buyers of the finest white oaks and ash. "Fifty cents a foot across the stump" was the standard price—a dollar for a two-foot tree. The landowners did not value the trees highly. They thought them merely an encumbrance and gladly accepted what they were offered.

After this era of "high-grading," the purchase of selected trees of exceptional quality, came—but not until the seventies and eighties—the period of timber development on a larger scale by companies that bought wide tracts of land and set up mills to saw the logs into lumber. As late as 1882 the penetration from the North had proceeded no farther than Nashville, which was an outlet for rafts of logs and barges of lumber from the upper Cumberland River. There was some talk then of establishing large hardwood mills near Memphis, but this was not done until later.

The forest resources of West Virginia were described in 1880 as "untouched"—which was only relatively true—and the "untouched" condition did not continue long. There had been sawmills in West Virginia, like that of the Parkersburg Mill Company, as early as 1825. There were two band mills at Charleston in 1882. Rafts of logs went down the Ohio from West Virginia to Cincinnati mills in the early eighties; and by 1890 the pioneer big-scale Appalachian operators began to move in. Since then West Virginia has been continuously an important lumber-producing state, and now it is the home of the country's largest hardwood manufacturing plant: the triple band mill run by the Meadow River Lumber Company at Rainelle.

William M. Ritter, today the recognized dean of the hardwood manufacturing industry, was an Appalachian pioneer. He installed his first mill in West Virginia in 1890, and since that time has operated continuously and extensively in the Appalachian and Southern field. Although now retired from active management of his properties, he keeps closely in touch with the activities of the Ritter company's nine band sawmill plants, six planing mills and three flooring plants. Its timber holdings embrace a half-billion feet, and the company expects to maintain itself on a basis of continuous operation.

Another influential character in the early development of the Appalachian hardwood timber resources was Rufus H. Vansant. A native of eastern Kentucky, Mr. Vansant began his activities in the lumber and timber business in 1880 on the Little Sandy River in that state. In 1894 he organized the firm of R. H. Vansant and Company, at Ashland, Kentucky, and five years later took into the business two other pioneer Appalachian operators—John W. and Charles Kitchen —under the firm name of Vansant, Kitchen and Company. This firm acquired extensive holdings of hardwood timber, specializing in poplar, and for years the names of Vansant and Kitchen were prominent in the annals of the Appalachians.

The story of the early hardwood industry south of the Ohio River is a story of waves of popularity for one wood after another. The first operators coming into the South from the North bought nothing but walnut, and the first sawmills owned by outside capital were relatively small affairs set up just to cut walnut. As the supply of walnut in the immediate neighborhood of the mills was used up the mills might start to cut poplar—one of the few marketable hardwood species then in the South. The manufacturers of tight cooperage were the first purchasers of white oak, and they skimmed the cream, but left a plentiful growth. When quartered oak first became a featured wood, there was a prejudice against the Southern variety on the ground that it would not make good quartered lumber, but this was gradually overcome as the mills in the South learned how to quartersaw so as to produce the widest boards showing the most figure. Poplar gained in prestige until it was the favored wood for many uses—for siding, for interior trim and wagon and carriage bodies, and for the early automobile bodies.

Poplar "boxboards," used for these vehicle bodies, were wide boards which had to be cut from big logs. As the supply of big poplar trees diminished cottonwood began to take poplar's place. This substitution met with opposition, but history repeated itself when red gum replaced cottonwood.

One of the first to introduce cottonwood as a replacement for poplar was Charles F. Luehrmann, a pioneer St. Louis lumberman. Mr. Luehrmann was in the lumber business in that city for seven years prior to the War Between the States, and after four years in the Confederate army returned to St. Louis and engaged in the business again. He was one of the earliest operators of hardwood sawmills

in Arkansas, and through the St. Louis market he introduced the hardwoods of this region to a consuming territory which had previously been unacquainted with them.

Another outstanding pioneer in the utilization of the South's cottonwood timber was Herman Paepcke of Chicago. Mr. Paepcke was head of the Paepcke-Leicht Lumber Company, and the Chicago Mill and Lumber Company, large manufacturers of boxes. Recognizing the peculiar merits of cottonwood as a box material, Mr. Paepcke invested heavily in Southern timberlands before the close of the last century, and since then the companies which he founded have been foremost in the ranks of Southern hardwood timber operators, still cutting in stands of timber acquired through his foresight nearly fifty years ago.

Two hardwood lumbermen from Michigan who contributed signally to the development of the South's hardwood resources were S. B. Anderson and C. J. Tully. The Anderson-Tully Company invested heavily in extensive hardwood holdings along the lower Mississippi; and, with mills at Memphis and Vicksburg, is still a prominent factor in the hardwood trade.

Indiana lumbermen played a prominent part in the development of the South's hardwood timber, and many of the leading Southern hardwood firms were headed by ex-Hoosiers. One of the earliest was A. B. Nickey, whose son and grandson are still active in the business in a large way in Memphis. Mr. Nickey was a pioneer by nature—he was reputed to be the first man to quartersaw gum, and he was also one of the first to recognize the potential value of Southern gum timber, in which he invested largely.

The Southern hardwood industry has the distinction of including in its ranks what is regarded as the country's oldest continuous commercial sawmill operation under the same family ownership: the mill of R. F. Learned and Sons at Natchez, Mississippi. The present owner is Andrew Brown Learned. The business was started in 1828 by his grandfather, Andrew Brown, who bought a mill built three years before by Peter Little. This mill went through the various stages of advancement in machinery. It was originally equipped with an old-fashioned sash saw. In 1858 the sash mill was replaced by a "mulay" saw, and this in turn by a circular mill, and that in 1884 by a band mill—one of the first band mills in this country. It was the intent of the present owner to keep it going until 1928, so as to

round out a full century, and then retire. When 1928 arrived, however, the growth of available timber was found so abundant that he decided to run it a few years more until the supply gave out. But in 1951 the mill is still going strong, and the timber is still growing.

The rise of red gum to a position of usefulness and popularity was one of the outstanding features of the Southern hardwood industry. Only a few decades ago it was reckoned as of practically no value. Many millions of feet of big gum logs were burned in land-clearing in the Mississippi Valley before its worth was recognized. By dint of hard work the manufacturers of the wood made a place for it, and now it ranks among the most highly regarded of all the Southern species for making furniture and for a wide variety of other uses.

The experience with cottonwood and red gum has been repeated with many other hardwoods in the South: elm, hackberry, tupelo, soft maple, magnolia, pecan, willow, etc. Early hardwood timber cruisers scarcely ranked these trees as merchantable, and until relatively recent years many of them were not cut into lumber commercially. But as the sawmills' manufacturing and seasoning facilities improved, and as research revealed more and more about wood properties and possibilities, some form of utilization for practically all kinds of hardwood timber came into being.

It was only a few years ago that loggers in the hardwood forests of the South passed by the native pecan trees as worthless. Sometimes they were cut and sawed into lumber sold along with the hickory which the pecan closely resembles, but generally they were not cut at all. Now pecan is made into flooring, which is durable and attractive in appearance and has proved popular with builders, and is used also for paneled walls and for the manufacture of furniture where strength and even grain are desired.

Hackberry was another outcast wood for a long time, but it has been found to have numerous qualities of excellence. When cut into veneers and made up into panels it can hardly be distinguished from some of the high-priced imported woods.

Magnolia was long regarded as nothing more important than a tree that had big green leaves and sweet-smelling white flowers. But the magnolias of the forest, with their long-bodied trunks, unlike the trees seen familiarly on Southern lawns, produce a creamy white wood which makes beautiful "blond" interior finish and furni-

ture, and excellent Venetian-blind slats, which planes smoothly, ranks high for holding nails and screws, and, contrary to what might be expected, is as hard as black walnut.

An aspect that makes hardwood one of the most interesting—and one of the most difficult—branches of the lumber business is the wide variety of species which must be handled by those who make and sell it. The manufacturers of a wood like, say, Douglas fir, have only to master the qualities and peculiarities of that one wood. A hardwood manufacturer or wholesaler handles a score or more of species which vary widely in physical properties and appearance, in the way in which they must be sawed and seasoned, and in the channels through which they must be sold. A list of the ordinary, everyday kinds of hardwood lumber sold in the market is impressive in its length and its diversity: ash, basswood, beech, birch, buckeye, cherry, chestnut, cottonwood, soft elm, rock elm, red and sap gum, black gum, hackberry, hickory, locust, magnolia, soft maple, hard maple, white oak, red oak, pecan, poplar, sassafras, sycamore, tupelo, walnut and willow. These are but the ordinary, commercial species which in the regular course of business are sawed into lumber and are bought and sold in carload lots. There are also several "specialty" species, such as dogwood, holly and persimmon, which have some highly specialized use such as bobbins and shuttles, inlay, golf-club heads, etc., and which are not generally sold in the form of lumber but in smaller pieces cut to special dimensions. No hardwood manufacturer ever complains that his business is humdrum.

The business is complicated further by the fact that there are frequently two or three—perhaps many more—varieties of the same general species, with differing physical characteristics among the varieties. There is soft elm and rock elm; there is white ash and green ash and black ash and red ash; there is hard maple and soft maple—and then there is oak. Sargent in his *Manual of the Trees of North America* lists no less than fifty-six different varieties of the *Quercus*. But most lumbermen are not botanists, so they group all the oaks into two classes—red and white. Generally speaking, and for most purposes, the varieties sold as white oak are superior to the red and command a higher price; but for some purposes both are sold together as "mixed" oak. A common way of telling the difference between them is that you can blow lengthwise through the pores of a short piece of red oak, but white oak's pores are closed tight.

Since hardwood lumber is so largely used for furniture and other such finished products, it is perhaps only natural that an increasing tendency has grown up in the trade to fabricate the parts for them, in either finished or semifinished form, at the sawmill. This material, cut to exact dimensions, is known as dimension stock or simply as "hardwood dimension"—not to be confused with the softwood "dimension" which is an entirely different thing.

Originally the manufacturers of all finished products using hardwood lumber as a raw material bought the rough lumber from the sawmill and shipped it in that form to their factories where it was sawed and turned or shaped or glued up into the parts going into the finished piece of furniture, automobile, refrigerator or whatever was the end product. This, obviously, involved a great deal of waste in material and also waste expense in transporting the rough lumber for a long distance. Some of the manufacturers, especially those making such products as refrigerators and automobiles in which wood was not the primary material, eventually came to the conclusion that it was more efficient for them to buy the wood parts from woodworking plants especially equipped to make them. Accordingly a substantial business, the hardwood-dimension industry, grew into being. At first, such plants were—and many still are—operated as adjuncts to sawmills. Then separate dimension plants were established, entirely independent in their operations, buying their lumber from whatever source seemed desirable.

The business of manufacturing hardwood dimension has grown into one of major importance in the trade. A modern plant is furnished with a wide diversity of equipment—variety saws, planers, shapers, borers, mortisers, sanders, lathes, dry kilns, glue spreaders and glue presses. It is equipped to produce anything that can be made from wood. The dimension plant that is run in connection with a sawmill operation is generally not so elaborate, and confines its efforts to making such simple products as squares and small made-to-measure pieces which do not require turning or other complicated processes.

Another form of fabricated product not infrequently made at a plant operated in connection with a sawmill is hardwood flooring. There are indeed some very large manufacturers of it who do not make any lumber at all, but buy their rough lumber from the sawmill trade. On the other hand, there are many plants conjoined with sawmills that prove a means of more efficiently disposing of the lower

grades of lumber, especially oak. The consumption of hardwood flooring by the building trades of the United States has grown tremendously during the past few decades, and even moderate-priced homes are now considered incomplete without a hardwood floor.

Old-time hardwood lumbermen as a rule have been somewhat skeptical of the possibilities in reforestation and sustained-yield logging, particularly in the mountainous region where growth is often slow and the comeback of the trees not so noticeable as under more favorable climatic conditions. It is an admitted and undeniable fact, however, that some hardwood trees in the bottom lands and along the streams of the Lower South grow as rapidly as the average softwood. This is conspicuously true of such species as cottonwood and willow which, along the lower Mississippi, have produced recurring crops of merchantable timber within the lifetime of present operators. It is also true of some species which are not commonly regarded as being particularly fast growers, such as walnut, ash and red oak. These trees grow much more rapidly than the average layman—or lumberman—suspects. In Mississippi, on good soil, red oaks have been observed which reached a diameter of twenty-two inches in twenty-four years. Many of the walnut trees from which gunstocks were manufactured for World War II had grown up to merchantable size since World War I, twenty-five years before. In propitious conditions, the mountain hardwood species also grow with surprising rapidity.

As a matter of fact, many hardwood manufacturers in the South are now maintained in business by the capacity of the trees to reproduce themselves in a comparatively short space of time. Only a part of the hardwood sawmills operate on logs cut from their own timber. The other mills buy logs from farmers and from scattered small tracts of privately owned timber. When the growth rings of such logs are examined they frequently reveal that they have grown to saw-log size within a few decades. As more and more owners of small tracts of timber become acquainted with the advantages of selective logging, fire protection and the other simple essentials of practical forestry, it is probable that the available annual crop of hardwood saw-logs will multiply in a way not suspected by most lumbermen.

It would be over-optimistic to claim that the possibilities in hardwood forestry, including all species and regions, are as promising as

in softwoods. There are, however, too many examples of rapid hardwood growth in favorable circumstances to justify the pessimism that has characterized the thinking of many hardwood men.

Of the total production of hardwood lumber in 1947, 68 percent was in the South (including the Appalachians). The Lake States provided 12 percent, and the remaining 20 percent was divided among all the other states, principally Pennsylvania, Indiana, New York and Ohio.

Cypress

Cypress, a distinctly Southern species, grows in greatest volume in the far South, principally in the swamplands close to the seacoast. It is to be found also further inland growing in scattered "brakes," generally in less extensive stands than on the coast. Its botanical name is *Taxodium distichum,* and, although there has been some difference of opinion, the botanists and experts of the Forest Service now seem to agree that this is the only species, that the different kinds of cypress trees in different parts of the South are merely varieties of this species.

In the lumber trade there is a differentiation between "tidewater red" and "yellow" cypress—respectively the coast and inland varieties. A definite geographical line of demarcation between the "red" and "yellow" producing territories has never been agreed upon in the trade. The Office of Price Administration, in fixing cypress ceiling prices during World War II, drew such a line seventy-five miles inland from the Atlantic and Gulf coasts, but it provided also that producers more than seventy-five miles from the coast were permitted to prove that in the past their lumber has been accepted by their buyers as "tidewater red." The members of the Southern Cypress Manufacturers Association have adopted the designation "Tidewater Red Cypress" as being the proper descriptive term for the lumber made from the coast timber, most of which grows in the tidewater belt. The manufacturers of yellow cypress, generally speaking, simply call their lumber "cypress" and sell it as such. There is generally some difference in the color of the heartwood of the red and yellow varieties, but the most conspicuous physical difference is that the sapwood ring in the tidewater red is very narrow, and in the yellow or inland is a wide band. Since the heartwood of the tree is the part

particularly resistant to decay, it naturally follows that the all-heart lumber is preferable on the score of durability.

The cypress is a tree striking in appearance. Growing as it does in soft, swampy ground, frequently in water, it anchors itself by throwing out roots in a wide buttressed base—or, as it is commonly expressed by the lumbermen, it is swell-butted. On this account it is sometimes necessary in logging operations to build a platform around the base so the men who cut the tree down will have a place to stand. Another peculiarity is that the cypress tree is surrounded by sprout-like "knees." The exact function of these knees is not definitely known, but some botanists think that the submerged roots breathe through them.

Cypress is a cone-bearing tree, and therefore properly classified as a softwood, though, unlike most softwoods, it is not evergreen but drops its needles in the winter. Also, although a softwood, it frequently is to be found growing along with hardwoods—especially the yellow type—and numerous Southern hardwood manufacturers cut cypress and carry it on their yards along with their standard stocks. The grading rules of the National Hardwood Lumber Association include rules for the inspection of cypress, although most of the cypress —practically all of the tidewater red—is shipped and graded under the rules of the Southern Cypress Manufacturers Association.

More than any other kind of lumber, cypress affords conspicuous evidence of the beneficial effects of advertising and trade promotion. At first its manufacturers entered into a co-operative advertising program to acquaint the lumber-buying world with the peculiarly good properties of tidewater red. Year after year they maintained a campaign of publicity which resulted in making the name cypress synonymous with durability in the minds of the building public. "The Wood Eternal" they have called it, and the home-builders have come to regard it as just that. Cypress has the merit to back up its advertising claims. The slogan "Cypress Defies Decay" is enforced by scores of examples of cypress which has defied decay, a record of durability which is measured not in years but in centuries.

The exact date of the earliest manufacture of cypress lumber in this country is shrouded in some mystery. There is a written record of an appeal from the early Spanish settlers in St. Augustine in the latter part of the sixteenth century that slaves be sent them from Havana to saw timber. It seems probable that the primitively pit-

sawed timber was intended for Fort San Marco and the Governor's House, built at about that time—1577—and built largely of cypress, so this was probably the first lumber sawed on this continent. The cypress used for the doors and other exposed woodwork of Fort San Marco (Fort Marion) is still sound and excellent after more than three hundred and fifty years.

Even before that the Spanish settlers in the southeastern part of our country seem to have known about the lasting qualities of cypress. Fort Charles, which they built on Parris Island, South Carolina, in 1566, was palisaded with cypress logs. The fort was long since destroyed, but the log ends remaining in the ground show no signs of rot.

Perhaps the Spaniards were told about cypress by the Indians. Certain it is that the Indians of the lower South made their dugout canoes or pirogues from cypress logs, having found by experience that exposure to water had no effect on the wood. Natives of the Southern swamps and bayous still prefer a cypress pirogue to any other form of skiff or canoe.

Cypress manufacturers are proud of the fact that the oldest wooden doors in existence are the cypress doors of Saint Sabrina's Church in Rome. These doors, made about 425 A.D., are carved to represent the life of Christ, and are said to be the earliest illustration of the Crucifixion extant. After more than fifteen hundred years' exposure the doors are still quite sound. Decay has not touched them. The European cypress, it should be pointed out, is a member of the *Cupressus* species; but botanists say that the chemical elements of the European wood and the American *Taxodium* are so similar that the toxic elements in one are almost identical with the other.

In this country cypress has lasted—as windows, doors, siding, shingles, fencing and exposed timbers—for as long a period as men have built any sort of structure. Cypress manufacturers can show you another sixteenth-century relic: pieces of the perfectly preserved cypress well curbing unearthed on Manteo Island, North Carolina—the site of Sir Walter Raleigh's "Lost Colony." This was perhaps the first well dug by Anglo-Saxon settlers in America—and the cypress well curb is all that remains of the ill-fated colony where Virginia Dare was born. Midway Church, at Midway, Georgia, has cypress window shutters which have served since 1792; and in its churchyard

are cypress grave markers dated 1770. Through a coincidence, 1770 is also the date on the famous cypress bedstead grave marker in St. Michael's Churchyard in Charleston, South Carolina. "Exeter" plantation house near Charleston was built in 1770, and its cypress exterior woodwork remains in perfect condition. Throughout Louisiana are miles and miles of sound cypress fences more than a hundred and fifty years old.

In early American history cypress was the favorite wood for shingles. Many of the historical buildings and mansions of the Colonial period had cypress shingle roofs. Outstanding among the examples which might be cited is Mount Vernon. The historic home of George Washington was reshingled in 1913, at which time the carpenters removed shingles that had been put on the roof when the house was first built in 1743. Others had been applied in 1784, and still others in 1860, the last time the roof had been repaired. Even in 1913 the roof was still in good condition and did not leak, but some of the shingles had worn thin from weathering and were removed on that account.

Examples of the longevity of cypress might be given endlessly. One especially interesting example involves its use in the building of Coast Guard lifesaving stations. Congress authorized them in 1848, and the first one was constructed on Sandy Hook, New York, the next year. All six stations were roofed and sided with cypress shingles, which did not need replacement until a few years ago. Even then they were not rotted—they had just been worn thin by Nature's sandblast, the beach sand driven by the gales sweeping in from the sea.

New Orleans has shown itself an excellent proving ground for cypress—the exterior woodwork of practically all the houses built by the early settlers. The houses still standing, many over two hundred years old, are without sign of decay.

All these examples of durability involve the use of cypress in ordinary ways, exposed to the weather. Underground there seems no limit to how long it will last. Cypress logs, sunk in rivers or ponds for fifty or sixty years, when brought to the surface are perfectly sound. The first water mains in many a Southern coast town were made of bored cypress logs, laid end to end. They were laid in New Orleans in 1793, and when dug up early in the twentieth century were quite all right. The scientific world was startled a few years ago when

excavations for the Mayflower Hotel in Washington turned up prehistoric cypress logs and stumps which geologists estimated one hundred thousand years old—and which were not at all rotted. Even this was eclipsed when the end of Greenbury Point, opposite Annapolis, was washed away by high tides and cypress stumps, entirely free from decay, were revealed which scientists from Johns Hopkins and the Maryland Geological Society said were a million years old.

Commercial development of the cypress lumber first made itself felt as a factor in the American industry about 1880 or 1890. The early operators in the Southern swamps reaped rich financial rewards —well deserved. These swamplands, back then, sold at ridiculously low prices—from five to twenty-five cents an acre. Why not? Nobody thought it possible to get into these fastnesses and bring out the logs. It was obviously out of the question to log with animals, and to build logging railroads was impracticable. But the lumbermen who invested were guided by a sort of instinct. They felt the timber was valuable; and they felt that, somehow or other, they could figure a way to get it out of the swamps in spite of apparently insurmountable obstacles.

One of the earliest cypress manufacturers was Captain William L. Burton, who built a mill at Baton Rouge in 1884 which had a capacity of 40,000 feet a day and was hailed as one of the finest in the South. Captain Burton's chief claim to fame was that, prior to planting this establishment at Baton Rouge, he had operated a floating sawmill on the Yazoo River above Vicksburg. This mill had a daily capacity of 20,000 feet, and was a portable mill of the aquatic variety, moving from one stand of timber to another along the riverbank.

The first cypress logging was done by "swampers," by leisurely and primitive methods. At some convenient time they would sally forth into the swamp in their pirogues and deaden a number of trees by girdling them—cutting a ring entirely through the inner bark all around the tree. The swamper, while waiting for the trees to die, would perhaps take a temporary job with one of the big sugarhouses or spend his time fishing and trapping. In the spring when the Mississippi overflowed or broke the levee there would be enough water in the swamps to float logs out and so the swamper would return to his logging. Loading a few helpers into a pirogue, with a little food—and a little more whisky—he would go to his deadening, fell the trees and float them out to the nearest bayou. Here they

would be made up into "double-spliced rafts"—made up of ten trees abreast with a binder or splice, consisting of a young sapling, across them to hold them together by means of wooden pegs driven through auger holes. Two such binders were pegged to each end of the ten-log group, and they were thus held firmly together while being floated out to the mills.

This was slow and laborious work, but was the accepted method of logging cypress until the development of the first step in mechanization: the pullboat. This was a variation of the conventional slack-rope skidder—a stationary engine, with two or more large drums, using a heavy wire rope to pull the logs in and a lighter line to take the main pulling cable back from the engine to the woods. The pullboat consisted of a skidder of this type mounted on a scow, making a mobile unit which could be taken right into the swamp. Here the pullboat would be anchored in a bayou or a canal dredged out for the purpose, with the pulling lines fantailed out into the timber. The logs, after being hauled to the pullboat, were made into rafts and towed to the sawmill.

The first successful pullboat system of cypress logging was installed by William Baptist for the Louisiana Cypress Company of Harvey, Louisiana, in 1889. There had been one or two previous experiments with the use of boats in cypress logging, but the difficulty encountered in dragging the logs through the swamps caused them to fail. Mr. Baptist's contribution to the logging art was simple but effective. He devised an iron cone which fitted over the front end of the log and kept it from burying itself in the mud as it was snaked through the swamp to the stream where the pullboat was located. Bill Baptist was the uncrowned king of pullboat logging.

Later the operators adopted high-lead steam skidding, making use of spar trees, similar to the West Coast operations, and these skidders are still used by cypress loggers in the South.

In appearance, cypress lumber resembles the softwoods, but has a uniquely bright, shiny appearance when dressed. It holds paint well, and, besides its peculiar adaptability to exterior use, it is a good wood for interior finish, natural or painted.

One of the strangest looking of all the kinds of lumber produced is "pecky" cypress. A pecky cypress board is honeycombed with fissures and pockets from a quarter of an inch to an inch in diameter and from one to several inches in length, as though it had been

halfway devoured by a group of fat, hungry worms. Such boards do not come from any particular variety of the cypress species, but are cut from occasional trees which happen to have been infected during their lifetime with an odd fungus known as "peck." It dissolves the wood fibers in a manner resembling decay, but it has the property of building up resistance to its own progress, so that the cavities never grow very large. Also the fungus stops entirely when the tree is cut down, and a pecky cypress board, though it is naturally weaker structurally, is as sound as any other. In fact, having passed through the fungus attack, it is in a sense inoculated against decay-producing agencies and so finds wide usage in greenhouses, where conditions favoring decay are extreme. Pecky cypress has also gained some popularity as a distinctive wood for wall paneling and interior woodwork, where a novel effect is desired.

The total production of cypress lumber in 1947 amounted to more than 240 million feet. It is employed mostly in construction work, particularly in exteriors, and industrially for vats and tanks, cooling towers, boats, greenhouses and other purposes where its peculiar properties are valuable.

Red Cedar

A Southern species which is of limited distribution and production but of considerable commercial importance is the aromatic red cedar (*Juniperus virginiana*). This tree, considered a softwood, is found in spots scattered throughout the eastern United States, but principally in the South. At one time its production centered in Tennessee and in some sections it is still known as Tennessee red cedar. Once the only wood used in the manufacture of pencils, its use for this purpose has declined, and today only a small percentage of the pencils are made of this wood. The red cedar's principal use now is in the manufacture of cedar chests and lining for closets, its reputation as a preventive of moths making it a favorite for these purposes. It is also used to a limited extent for the production of buckets, churns and small tubs.

Chapter VII

HOW LUMBER IS MADE

LUMBER is manufactured in a sawmill. The raw material of the sawmill is the log. The log comes from the standing timber. But there is many an operation necessary between the tree standing in the forest and the board, joist or timber as it finds its ultimate use. The tree must be felled and cut up into log lengths which can be conveniently handled. Then it must be transported to the sawmill, where it is sawed into boards or whatever other product is desired. Then the lumber must be seasoned before it is finally sold and shipped to the retail yard (which sells it to the ultimate consumer) or to the factory which manufactures it into a finished product. All this requires a succession of difficult and tedious tasks. Few if any manufactured products require as much moving and handling and as much intricate and backbreaking work in their production.

Logging

The first operation in the process of converting a tree into lumber is to cut down the tree and saw it into log lengths. This sounds simple, but there has developed in the logging industry a definite technique for doing it in such a way as to get the maximum value out of the tree and do the least damage to surrounding timber.

The act of cutting down a tree is called "felling." In Western logging operations the men who do it are called fallers; but in the South they are merely called timber cutters—or, sometimes, "flatheads." Cutting the tree into log lengths after it is felled is called "bucking" in the North and West, or "logging off" or simply "logging" in the South. The men who do the bucking are called buckers. Fallers and buckers generally operate in teams of two. In some sections, notably in the South, the tree is cut down and sawed into logs by the same crew of two men; but in the West the general practice is for separate pairs of buckers to follow the felling specialists. Both felling and bucking are jobs calling for skill and judgment, and

the manner in which this work is done has much to do with the profit or loss of the operation.

The faller's tools are the ax, crosscut saw and wedges. Generally he carries in his hip pocket a soda-pop bottle, its neck stopped with straw or pine needles, filled with coal oil which is used to lubricate the saw and remove rosin from it as the cutting proceeds.

The crosscut saw is a simple and familiar tool, but wonderfully ingenious. Its cutting edge consists of a series of alternating cutting and raker teeth, arranged in different patterns for different species and regions. Each cutting tooth is a small chisel, whose keen edge cleanly severs the wood fibers as it is drawn across them. The space between the cutting and raker teeth allows room for the sawdust, and the rakers rake this sawdust out as the saw blade comes out of the cut. The crosscut saw is the foundation stone of the logging and lumbering industry.

During recent years there has been a very great increase in the use of power-driven chain saws for felling and bucking. These chain saws have proved very popular, and have largely replaced the old-fashioned, muscle-powered saw in many producing regions. There is also another type of power-driven saw, employing a small circular saw, but this saw is used only to a limited extent, principally in the production of pulpwood.

The faller's first duty is to study the tree to be felled and decide the direction in which he wants it to drop. Numerous factors enter into this: safety, conservation of the young timber, facility of bucking and removal, etc. The direction decided, the faller cuts a notch or "bate" on the side on which the tree is desired to fall. This is called the undercut. The fallers then bend to the backbreaking job of sawing through the tree with the crosscut saw. Sawing proceeds from the side opposite the undercut, until the saw binds in the cut. A wedge is then driven into the cut behind the saw to release it and sawing proceeds. When the tree is completely severed it gives a slight shiver, topples over on the side of the undercut and crashes to the ground at the spot selected by the fallers.

In the West the fallers also make use of springboards to stand on while sawing. The springboard is inserted in a notch cut in the tree, and enables the men to avoid the difficulties of irregular ground and swelled or defective butts.

In modern practice fallers generally cut the tree as close to the

ground as possible, leaving a minimum of stump; this in the interest of deriving the maximum value from the tree.

In the North and West, tradition demands that the fallers cry "Timber!"—or, generally, "Timber-r-r-r!"—as the tree falls. In the South they merely give a warning shout, a sort of sylvan modification of the Rebel yell.

The length of logs into which the fallen tree is bucked depends mostly on standard lengths of lumber in the species being cut. A mill may, however, sometimes cut stock of special lengths, and that fact determines the length of the log. The presence of limbs, knots or other natural deformities of the individual tree may also be a determining factor. As a margin of safety, logs are cut three or four inches longer than specified lengths. It is the duty of a bucking crew to trim branches off even with the log surface; and, if the logs are to be ground-skidded, they are "nosed" by trimming a bevel edge around the small end. In some instances the full-length tree is carried to the sawmill and there cut into the desired log lengths.

The job of transporting logs from the place where trees are cut down to the point of utilization, generally a sawmill, is one of complexity and difficulty. In its simplest form the transportation problem involves nothing more complicated than loading logs on some form of vehicle at the point of cutting and hauling them to the mill. Usually, however, especially on the larger operations, logs are first hauled or skidded to a yarding point or skidway, there to be loaded on trucks or cars and conveyed to the mill. Various processes are used in various regions and under varying topographical and geographical conditions.

In the days of primitive sawmilling the mills were water-driven and therefore located on the watercourses. These offered the most obvious and convenient means of getting logs to the mill, either by driving or rafting. With the coming of the steam engine, however, sawmills were freed from their bondage to rivers, and log-hauling methods were changed accordingly. Teams which had formerly been used only for yarding the logs on riverbanks were now used to haul the logs directly to mills. Then came logging railroads and steam skidders, and still later, the truck and tractor.

Today in some remote sections are found vestiges of all the earliest forms of logging. The log drive is still a factor in the Northeast and in the upper Rocky Mountains. Rafts may still be seen on some of

the rivers. Sleds drawn by horses are used in the Northern winter-time logging. Mules and oxen are used for short hauls in many sections, notably the South. One Southern sawmill located near the winter quarters of a circus has even experimented with elephants for moving its logs. The steam skidder is still a factor in getting out big timber from rough and inaccessible locations, but is not used so widely as it once was. The logging railroad, in modified form, continues where the timber area is large enough to justify its use. But, generally speaking, the tractor (of the Caterpillar or crawler type) and the motor truck are the loggers' principal means of transportation today.

A unique form of logging which has been practiced in the New Jersey marshes since 1812 is what might be called "timber mining," as the logs are dug out from under the soil. These trees, which lie buried in swamps in the southern part of the state, are of the white cedar variety (*Chamaecyparis thyoides*). They grew, centuries ago, in the fresh-water swamps of that region, but the supposition is that they were killed when for some unknown reason the region was inundated with salt water. The trees then died and slowly, year by year, were blown down or fell over, and now lie buried under the accumulation of peat and muck. The trees are piled on top of each other to a great depth, but the top layer is only a few feet under the soil. The log-digger locates them by means of a sharp-pointed iron rod with which he probes the ground until the point encounters one of the fallen trunks. It is then unearthed, and is manufactured into lumber or shingles as desired. The length of time since the trees were submerged is unknown, but is thought to have been several hundred years. The trees, nevertheless, are still entirely sound and show no signs of decay. Shingles made from them last sixty or seventy years, and many of the houses around Dennisville, New Jersey, are covered with shingles made from the product of these tree mines.

The biggest forward stride in the mechanical advance of logging came with the introduction of steam locomotives, which made possible the logging railroad. So long as timber-development projects were pinned down to the rivers or held within the radius of transportation by animal power, many timber areas were too inaccessible to be commercially developed. The logging railroad, however, opened up all such remote areas. It was a particularly potent force in the development of the pine forests of the South.

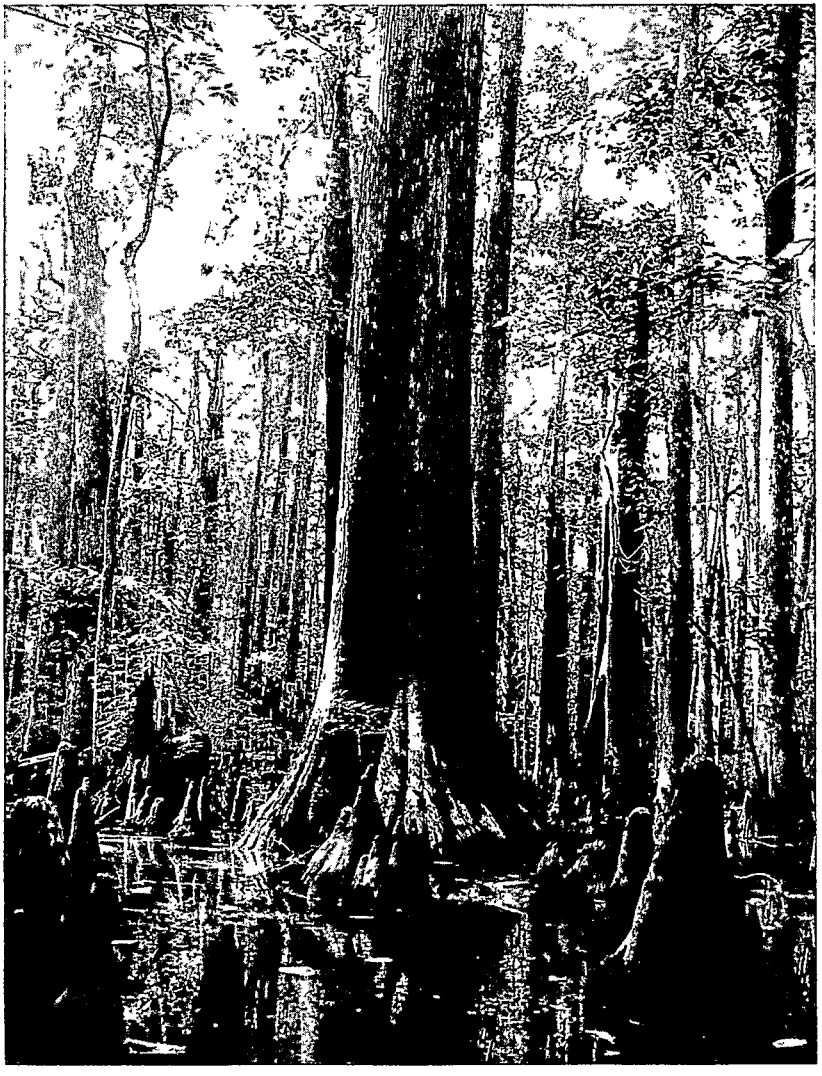
The first primitive logging railroads used roughly squared-off wooden poles or sawed stringers for rails, and were called "pole roads" or "stringer roads." The log cars were generally pulled by draft horses. Gradually the lightweight "dummy" engine replaced the draft horses. Then steel-rail logging roads were built in Michigan in the late seventies. Before long the logging railroad became an essential part of a progressive lumbering operation, using heavy steel rail and large, high-powered locomotives.

In the heyday of railroad logging there were thousands of miles in operation. Some of the roads were narrow-gauge, but most of them were standard-gauge and many of them formed links in systems which later grew into important common carriers. Today some of the big lumber companies on the West Coast and in the South still maintain track and roadbeds which would be a credit to a trunk-line common carrier, and use the most modern type of Diesel or electric locomotives; but on the whole the advent of modern tractors and trucks has cut down the use of railroads to a very great extent.

Choosing the location of a logging railroad requires a high degree of engineering skill. The road must be laid out with a view to economy in original cost and maintenance, for generally its lifetime may be limited. Main lines are usually located with the idea of getting into the timber by the shortest practical routes, which is no great problem in the flat pine lands of the South, but involves considerable difficulty in more rugged terrain. The main line established, spur lines—generally of temporary construction—are laid off into the timber, and logs are yarded along these spur tracks for loading onto cars.

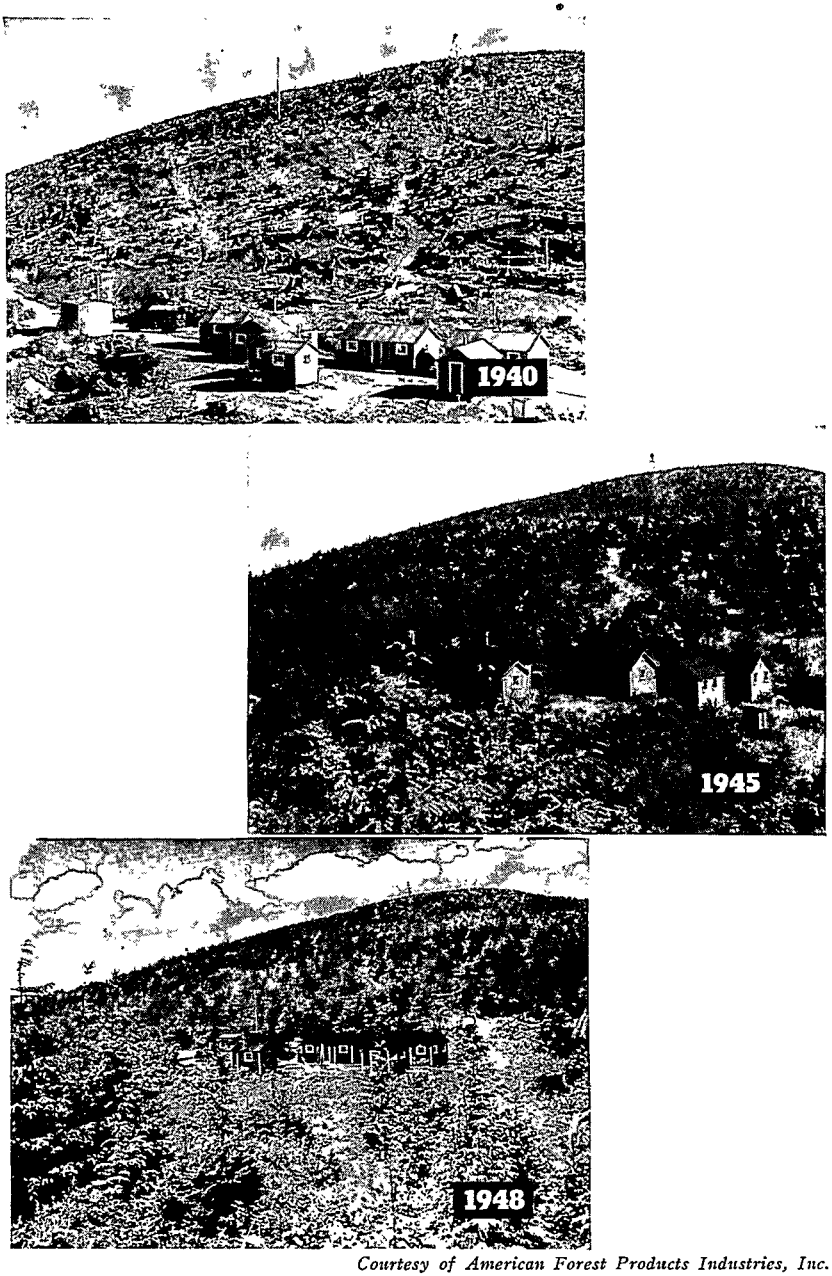
Methods of yarding the logs along the railroad track vary in different sections. Some operators still use animal power—horses, mules or oxen. When animals are used logs may be handled on one of many suitable vehicles: four-wheeled or eight-wheeled wagons; bummers—a type of two-wheel cart which supports the front of the log but drags the other end along the ground; or high-wheeled, slip-tongue carts in which the logs swing beneath the axle of the wheels and drag along the ground.

In the early days of logging it was soon found that some trees were so large or so located that they could not be effectively handled by teams, and this disadvantage caused the adoption of "donkey" engines for yarding purposes. A donkey engine in its simplest form is a



CYPRESS "BRAKE"

A cypress "brake" in Louisiana, showing the characteristic "knees" through which the cypress breathes.



Courtesy of American Forest Products Industries, Inc.

TIMBER COMES BACK NATURALLY

stationary steam engine with a drum carrying a steel cable. The cable is carried out and fastened to the log, and the engine reels up the cable, pulling the log in to the dump.

A natural development from the donkey engine was the ground skidder and loader—an engine mounted on a steel frame, which may be moved along the railroad track to any desired location on the right of way. It is equipped with pulling booms, by means of which the logs are brought in by the skidding lines; and it may carry also a loading boom to load the logs onto the cars.

Invention of the steam skidder is credited to Horace U. Butters, a white pine lumberman of Ludington, Michigan. In 1883 he conceived the idea that advances of the machine age could be directed into the replacement of animal power for moving logs, and the outcome was his construction of the first overhead logging cableway operated by wire rope. When Mr. Butters went south in 1890 and started a cypress operation at Hub, North Carolina, he added another laurel to his record by building the South's first steam skidder there. Thus to Horace U. Butters goes the honor of having revolutionized logging methods, in both North and South.

The most spectacular developments of power skidding have been in the high-lead yarding and aerial tramways—systems now almost a thing of the past in the South, except in the cypress swamps and some mountain operations, but generally in use in the big-timber operations on the Pacific Coast. In high-lead logging the main cable passes from the engine drum through a block at the top of a tall spar tree—from one hundred fifty to two hundred feet or more in height—and thence to another block attached to a stump in the woods, perhaps two thousand feet from the main spar. The cables are rigged so as to lift one end of the log off the ground, in which manner it is pulled in to the log deck at the railroad. The aerial or loading-line system involves the use of two tall spar trees, the head spar at the railroad track and the tail spar in the woods, between which stretches the stationary main cable. Logs are assembled, or cold-decked, at the tail spar, usually by a ground skidder. A carriage or trolley runs along the cableway, with a line down to the ground equipped with hooks or a noose of steel cable, called a "choker," by which the logs are lifted up and the trolley then pulled back to the head spar.

Both these systems of logging are picturesque and dramatic in their operation, but even more so in their preliminaries. Preparation

of the spar trees is one of the most spectacular performances in the whole process of making lumber, and involves a degree of courage, skill and daring required in few industrial activities. Tall, straight trees, generally more than two hundred feet high, are selected for spars. But the tree cannot be used and fitted with all its rigging until its top and any side limbs are removed. And how can the top of a two-hundred-foot tree be cut off? Here enters the "high-climber," the nerveless acrobat of the logging industry, who takes in his stride this dangerous but necessary task.

A high-climber's equipment consists of climbing spurs, like those used by a telephone lineman, and a loop of steel-cored rope fastened to his belt. He has the agility of a cat, his muscles are like steel, there is ice water in his veins, his heart knows no fear. He carries aloft with him the tools of his trade: a double-bitted ax with a razor edge and a one-man crosscut saw. His first step is to pass his loop of rope around the trunk of the tree, making sure that both ends are securely fastened to his belt. He then digs his spurs into the bark, whips the loop of rope upward on the other side and rears back against it until his weight is supported by it. He reaches up with first one spurred foot and then the other, whips the loop of rope upward again, and so inches his way up the long, rough bole. As he comes to a side limb he lops it off with his ax—making sure not to cut his rope in two. When he finally reaches the proper altitude near the tree's top, he fixes his position firmly with his spurs and loop, and there, two hundred feet above the ground, proceeds to chop an undercut with his ax and saw off the top of the tree as calmly as though he were standing on the ground.

When the top of the tree is severed and topples over the high-climber hangs on for dear life, for here comes the most hazardous part of the whole operation. If the cut is not cleanly made, the top may take a slab or giant splinter off the side of the remaining trunk. That sounds simple, but it might be fatal, as it may cause the man's safety rope to squeeze him to death before he can loosen it. Even if the top falls cleanly to the ground, as it generally does, the high-climber is in for a thrilling few minutes as the tall trunk whips from side to side in a fifty-foot arc of vibration. Some daredevil high-climbers give a flashy finish to their job by standing on the top of the tree, after it has stopped vibrating, and maybe dancing a little jig; but such show-off tactics are frowned on by the mature riggers.

The top cut off, the high-climber's job has just begun. He must now inch his way back to the ground and then climb up again, loaded down with the heavy block, or pulleys, and a length of Manila rope. He fastens the block to the top of the tree, and through this block passes the rope, the end of which he carries with him as he descends. It is by this rope that further rigging of the steel cables is accomplished. This is in itself no child's play, since the wire ropes, which look like threads as they whip through the air, are in reality heavy steel cables, sometimes more than two inches in diameter.

Steam skidding was for a long time looked upon as the only practical means of achieving quantity production in a logging operation, but its shortcomings were always recognized. In the first place, it was destructive of young timber and made selective logging extremely difficult, if not impossible. Furthermore, it was an expensive method, and the original cost of installation ran into large sums. This was true even of the relatively light equipment used in the South; the high-lead and sky-line outfits used in the West sometimes cost as much as $100,000 or more. Moving such equipment is difficult and costly, and so it is generally employed as long as possible at one location.

A complete change in logging methods and in the viewpoint of the whole lumber industry came with the change-over to tractors and motor trucks. It is not too much to say that their use has revolutionized the science of logging. It also made possible a basic change in technique which makes selective logging both practicable and profitable.

The principle of the crawler-type tractor—now used widely for many industrial purposes as well as in the powerful armored tanks of warfare—dates back so far in history that its origin cannot be definitely attributed. Application of the principle to practical commercial vehicles, however, was made by two American pioneers: Benjamin Holt and O. A. Lombard. Mr. Lombard, himself a logger in Maine, introduced it into logging operations. To Mr. Holt belongs the credit for recognizing its great possibilities and providing the genius and enterprise through which it was commercially developed and popularized. Mr. Lombard, while logging in Maine, applied the principle of the endless tread for driving wheels to a conventional geared logging locomotive, in order to adapt the locomotive for hauling logs in the snow. The then-unique tread was attached to the locomotive in

place of the driving wheels, and movable sled runners were installed in lieu of the front wheels. The crawler tread drove the machine across the snow and a "pilot" seated on the front of the contraption steered it by means of a wheel attached to the runners. About the same time the same principle was used on a logging locomotive by a machinery manufacturer in Wisconsin. Then year by year the crawler-type tractor was improved and developed until it reached its present stage of efficiency. One of the first leading manufacturers of this type of equipment was the Holt Manufacturing Company, which adopted the word "Caterpillar" as the trade-mark for its particular make of tractor. The Holt Company was eventually succeeded by the present Caterpillar Tractor Company, and tractors of this crawler or track-laying type are now made by a number of other firms, such as the Allis-Chalmers Company, the International Harvester Company and the Oliver Corporation.

The tractor's adoption by the logging industry came slowly, with the customary resistance to change. Mountain loggers said it would probably be a great thing for swamp logging, but it wouldn't work in the mountains. Swamp operators knew it wasn't adapted to their peculiar conditions, but thought it would probably be a great thing for logging in the mountains. Eventually, however, the resistance was broken down by the tractor's inescapable record of performance, and today both mountain and swamp loggers regard it as an essential device for carrying on their business.

The manner in which tractors have been adapted to the various processes of logging has been little short of remarkable. At first their use was limited to ground skidding, as a substitute for animal power. Then as tractors were improved and equipped with more powerful motors they came to be used as a substitute for cable yarders in yarding larger logs. Also the more powerful tractors were able to tow larger loads.

Then some genius equipped a tractor with a towing winch on the rear end. The winch, powered by the tractor's engine, made it possible for the tractor to cable-yard its own logs and rendered it independent of the animals formerly used. Another important improvement was the powerfully built steel logging arch, an elaboration of the old high-wheeled slip-tongue cart used in team logging, but capable of carrying much heavier loads and handling bigger logs.

In country too rough or too steep for the operation of the arches,

some tractor loggers use skidding "pans." A pan is an oval-shaped piece of sheet steel, about ten feet wide and five feet long, which is attached to the end of the skidding line in such a way that the front ends of the logs rest upon it. This pan serves as a sort of sliding surface which keeps the logs from digging into the ground and thereby increasing the resistance to skidding. Some tractors are now equipped with loading booms and can be used as log loaders; others have a double-drum hoist attachment which can be used for high-lead logging and which converts the tractor into a light, mobile cable yarder of great flexibility and adaptability.

The first tractors were equipped with gasoline engines, and such tractors are still made and used. Of increasing popularity among loggers, however, is the Diesel-powered type, with its engine of 75 horsepower or more, which hauls bigger loads at lower cost and gives the tractor a new range of possibilities.

The tractor has been a godsend to the lumber industry. It has increased efficiency and lowered costs in logging. It has made available remote and hitherto useless tracts of timber. It has converted selective logging from an abstraction to a practical reality. A modern lumbering operation could hardly be carried on without powerful, adaptable and efficient track-type tractors.

Closely associated with tractors in the new, modern method of logging are motor trucks. It seems only yesterday that they were a distinct novelty around a lumber operation; today there is hardly a manufacturer or logger in the country who does not use them. He may be a one-gallus, part-time logger-farmer who uses a ramshackle secondhand truck to haul a few logs occasionally to some near-by sawmill. Or he may be a big operator, employing scores of trucks in logging as well as in handling the finished product. And, during recent years, there has been a steadily increasing use of trucks for delivery of lumber from the sawmill to the buyer, such deliveries sometimes involving hauls of several hundred miles.

Trucks are particularly valuable in developing scattered tracts of timber, and they also fit in admirably with a system of selective cutting. In fact, the timber-saving practices of modern selective cutting are impossible without tractors and trucks. If the ground is not too rough the trucks can be driven right into the woods to be loaded, the same as a team or wagon. Their efficiency in hauling logs increases with the quality of the roads over which they operate, and most log-

ging operators have found it profitable to invest in road-building equipment and construct fairly good private roadways for their trucks. Frequently, however, a large part of the truck's haul may be on a public highway.

In some parts of the country lumber operations would be practically paralyzed without trucks. In the pine manufacturing region of New Mexico and Arizona, it is stated, 95 percent of all the logs are hauled by trucks. The Southern Pine Association reports that 98 percent of the Southern pine production is handled by motor trucks at some time from the stump to the consumer. With other species and in other regions the usefulness of the truck is comparable.

A novel method of log transportation used to a limited extent on the Pacific Coast until recently was the ocean-going log raft. Unsuccessful efforts to raft logs across the Atlantic Ocean from Maine to England were made as early as 1792, and adventurous spirits revived the idea from time to time through the following years; but it was not until 1906 that a Pacific Coast logger, Simon Benson, devised a form of raft that would withstand the rigors of an ocean voyage. From then until 1941 Benson rafts made regular trips of over a thousand miles from the Columbia River down the coast to California mill points, and were also employed in bringing down spruce logs from Alaska. These rafts, containing five million feet or more of logs, were built according to a system patented by Mr. Benson, with the logs securely chained together, all according to a precise system of arrangement and fastening. One of these cigar-shaped, ocean-going rafts was an impressive sight. It was more than 800 feet long and 55 feet wide—bigger than most ocean liners. Its logs were stacked on top of one another to a depth of 35 feet, and it drew 28 feet as it rode in the water. The raft was towed by a powerful tug, and the job of hauling the big craft to its destination was no mean piece of seamanship.

In some sections and in some circumstances other means of transportation are employed in moving logs from one place to another. In mountainous regions use is made of such gravitational devices as flumes and sluices, slides and chutes, inclines, etc.

A flume is a narrow trough, with a constantly maintained downgrade, in which a stream of water carries the logs (sometimes lumber) down to the mill or to the log deck. A typical flume may have a trough that is either V-shaped or square-bottomed. It will be supported on a rough frame foundation, which is elaborated into a tres-

tle when it passes over a valley or hollow. The V-shaped trough will be perhaps 18 inches high and 36 inches wide, depending on the size of timber handled; the square-bottomed type may be larger. Use of flumes presupposes an abundant supply of water, which is fed into the trough at its highest point and supplemented by feeder troughs along the route. Flume construction is carefully engineered, with a maximum grade of about three percent (diminishing toward the bottom) and curves no greater than eight percent. Crews of runners armed with pickaroons or peaveys are stationed on the walkway along the flume to keep the logs moving. The speed of the logs' downward journey may be regulated by the input of water, as well as the grade, but will generally not be in excess of three or four miles an hour.

An incline is a mechanical means of raising or lowering logs, generally in cars on a track, on grades which are so steep as to make operation of locomotives impossible. In its simplest form an incline consists of a hoisting engine at the top of the incline which hauls up the loaded cars or drops down the loaded ones by means of a drum and steel cable. Some inclines are designed on a principle of counterbalancing, which brings up an empty car as the loaded one goes down.

Slides are just what the name indicates: an arrangement by means of which it is possible to slide the logs downhill. They generally follow the topography of the land on a downward grade, and are mostly used where the construction of logging railroads is not desirable or economically feasible. A slide may be merely a smoothed-off track down a slope in the shape of a trough or furrow; or it may consist of a sort of chute constituted of parallel logs or poles a few inches apart, supported on cross skids like railroad ties. Logs may be hauled along these slides by teams or other power; or if the grade is sufficient they may descend by gravity.

Sawmilling

The saw was known to the ancient Greeks, who deified its inventor, and the genealogy of the sawmill reaches back at least to the fourteenth century. There were sawmills, driven by water power, in operation in Augsburg, Germany, in 1322; but it is doubtful whether these mills were efficient or successful. Historical records show that from time to time during the next two or three centuries sawmills were built in Germany, France, Norway and the Netherlands. In

1660 a mill was built in London by a Dutchman, but England was not yet ready for the machine age and the outraged British pit sawyers, who made lumber by hand, chopped down the Dutchman's mill with axes and sent him scurrying back to the Continent. Again, in 1700, a brave Briton named Houghton started to build a power-driven sawmill, but the pit sawyers again discouraged his effort by violent means. This happened once more about sixty years later, but before the end of the century the hand sawyers' wrath was appeased and a sawmill was finally built in England, equipped with machinery brought in from Holland. The Dutch at that time seemed to have a monopoly on the manufacture of sawmill machinery. The first sawmills in the American colonies were imported from Holland, along with Dutchmen to erect and operate them; and in 1633 the Dutch West India Company built three mills in New Amsterdam, two operated by water power and one by the favorite Dutch motive power, a windmill.

For use in the manufacture of logs into lumber there are two distinct types of saws, and therefore two general types of sawmills: circular and band mills. The circular saw is the older type. As its name indicates, it is a large steel disk with saw teeth in its circumference. It may be of either the solid or inserted-tooth variety. Solid-tooth saws have the teeth cut into the steel itself; the others have an ingeniously devised removable tooth securely fastened in recesses made in the saw's rim. In saws of this type dull or damaged teeth may be easily replaced with new ones; in solid-tooth saws, the teeth are sharpened with a file or grinding-wheel.

Invention of the circular saw was the first real improvement in lumber manufacturing equipment. The sash saw and mulay saw were but mechanized applications of the old pit saw operated by two men. They substituted mechanical power for manpower, but the principle involved was the same: oscillating motion of a straight saw blade with teeth on one edge. The circular saw substituted the entirely new principle of continuous motion, and it was a vast forward step. Credit for inventing the circular saw is generally given to Benjamin Cummins of Burtonville, New York, who in 1820 hammered out, at his own blacksmith's anvil, the first circular saw ever seen. Aside from his qualifications as a blacksmith and inventor, Mr. Cummins seems to have been a person of many other interesting qualities, mentioned in a newspaper sketch soon after his death:

He was a first cousin to one of the Presidents of the United States; a slave-owner in New York State; a leading Mason, at whose table the very elect of the great state of New York feasted and drank freely of his choice liquors and wines; a vessel owner on the North River before the days of steamboats; a captain in the War of 1812, where, after having horses shot from under him, with one stroke of his sword he brought his superior officer to the ground for insult and because he was a traitor and coward and, after having been court-martialed, instead of having been shot he was appointed colonel in his place. He constructed a mile and a half of the Erie Canal through a bed of rock, and aided in the construction of the first ten miles of railroad built in the United States.

This remarkable man died in 1843 and is buried in a secluded cemetery near Richmond, Michigan, where he rests without benefit of the monument such a variegated career would seem to deserve.

Band saws are endless ribbons of steel with teeth in one edge—occasionally in both edges, in what are called "double-cutting" saws. Band saws used for cutting logs are made in lengths up to 44 feet or more and from 8 to 18 inches wide. The band saw was invented in England by William Newberry in 1808, but was not put to practical use until fifty years later.

The band sawmill as it is known in this country today may be said to be the invention of J. R. Hoffman, a lumber manufacturer of Fort Wayne, Indiana. Mr. Hoffman began his experiments with the use of the band saw for cutting logs as early as 1860, but he was handicapped by the difficulty encountered in getting a suitable saw made in the United States. After ten years of effort he obtained from France a band saw 6 inches wide and 50 feet long, and soon he had in operation at Fort Wayne the first band sawmill ever to cut logs into lumber. The saw worked around wooden wheels mounted on a wrought-iron column. Although somewhat crude, it was entirely workable and demonstrated conclusively the practicability of log band sawing. This first Hoffman mill was destroyed by fire soon after it was built, but was immediately replaced by another similar mill which was successfully operated by the Hoffman company at Fort Wayne until comparatively recent years.

The innovation was received cautiously by American lumbermen, and it was not until the eighties that sawmill operators of this country began to make general use of band mills. For the past fifty years, however, it has been the favored equipment in the larger mills.

Strangely enough, nobody knows exactly how many sawmills there are in the United States. The Census Bureau's report for 1947 (the latest available) shows 53,109 active mills and 8,442 idle mills. This is supposed to include all mills, large and small, but the figures do not take in all the very large number of small, portable mills with limited and irregular output, though together these produce a large part of the country's lumber. They are of the circular type, as are a majority of all mills in the country. There are less than a thousand band mills in operation, but these produce more lumber than the thousands of small circular mills. A portable circular mill will cut from 3,000 to 10,000 feet a day, depending on the species cut. A single band mill will cut from 4,000 to 6,000 feet per hour in softwoods, or about 25 percent less in hardwoods.

Circular sawmills are of varying types and capacities. Some of them are lumber manufacturing units reduced to the simplest form: a portable mill operated by a portable gasoline, Diesel or steam engine—or, occasionally, by a primitive water wheel. It may be operated by a farmer, to cut logs from his own wood lot and perhaps do a little custom sawing for other farmers who have a few logs they want to convert into lumber. He operates spasmodically, whenever convenient or necessary, and making lumber is only a side line with him. Then there is the portable sawmill operator who buys small tracts of timber, maybe only a few acres, and moves his mill from place to place to cut it, along with such logs as he may be able to buy locally. Other and larger circular mills are established in permanent or semipermanent locations to make lumber from logs bought in the community from farmers or small independent loggers. On the West Coast some of these mills are electrically driven with purchased power. Many of these smaller circular mills produce nothing but rough, green lumber and sell their output to some conveniently located concentration yard which takes the output of a number of such mills, seasons it, dresses it, and sells it in carload lots of desired grades and thicknesses. Larger circular mills will have edgers and trimmers for improving the appearance of the boards, and perhaps a planing mill to dress the rough stock to a smooth finish and a dry kiln to expedite its seasoning. If they manufacture hardwoods they generally season their stock by air-drying, stacking the boards in piles in the open air.

The band sawmill is a more elaborate type of manufacturing en-

terprise, involving a much larger investment than a circular mill and generally equipped with more facilities for the refinement of its rough product. It will always have edgers and trimmers, and probably other auxiliary equipment such as planing mill, dry kilns, dipping vats, etc. A single band mill is the conventional unit, but operators with a larger supply of timber or logs may require increased manufacturing capacity and achieve it by an elaboration or multiplication of the basic unit, the band mill, which is called the head saw. Capacity may be increased, for example, by the installation of a resaw—a type of secondary band saw which takes thick boards from the head saw and resaws them into thinner ones. In softwood mills the head saw is frequently supplemented by a gang saw. This is a powerful arrangement of reciprocating vertical saws which produces inch boards from large slabs of wood called "cants" cut from the log on the head saw, and introduces the principle of mass production into lumber manufacture. In some instances, there may be a log gang saw which saws the whole log into boards at one operation, but this type of mill has not been extensively employed in this country, although popular in Europe.

Where the log supply justifies it, an operator may install two or more band mills under one roof, with a corresponding increase in daily output. Double band mills are the exception rather than the rule; there are a few triple band mills; and in an occasional big-scale operation on the West Coast will be found as many as four or five mills in one plant. A mill of this latter type, with its gang saws and resaws, will produce a million feet or more of lumber in a day, as much as most band mills will produce in a month and more than many circular mills will cut in a year.

For comparison, let us consider a small portable circular mill and a single band mill as examples of their types.

The operator of a portable mill has two main objectives in locating it: he tries to find a location as close as possible to the timber, perhaps in the very midst of it; then he selects a site with regard to the convenience and adaptability of its topography. An ideal millsite will provide a gentle slope down which to roll the logs onto the saw carriage, a relatively level space on which to set up the mill, a level or downhill haul for removing the lumber from the mill, and an open space for stacking the lumber if it is to be yarded at the mill. Most

portable mills nowadays are powered with gasoline or Diesel engines (principally Diesel), but if a steam engine is used the site must be convenient to a supply of water.

The heart of the circular sawmill is the husk or frame. This husk has a main shaft or arbor on which the drive pulley and the saw are mounted. There is a saw guide which is designed to make the saw run straight and steady, a board spreader which keeps the sawed board pushed out slightly from the log to prevent the saw from binding, and a steel roller to carry off the sawed board. When the drive pulley is connected with the power unit, the saw revolves and the log on the saw carriage is brought against the saw and converted into boards.

The saw carriage in use on a portable mill is likely to be of the simplest possible type. Its chief parts are the framework, which is mounted on steel wheels and rolls on a light steel track; the head blocks, consisting of a base, knee and dogs, which hold the log while it is being sawed; the setworks, which make it possible to adjust the log successively to the proper sawing position; and some form of mechanism for propelling the carriage, generally called the drive or feed. The drive on a portable mill is most likely to be of the rack-and-pinion or cable type.

Labor requirements of such a mill are at a minimum. One man, the sawyer, handles the levers which control the movement of the saw carriage and start and stop the saw. A man or maybe two men ride the carriage, dogging the logs and setting the head blocks. Another man keeps the logs in readiness and rolls them onto the carriage when needed, probably with the assistance of the head-block setter.

If this portable mill has an ideal location, the logs will be bunched on sloping ground, parallel to the carriage, where they may be easily rolled down onto the carriage by one or two men equipped with peaveys or canthooks. With the log resting on the base of the head block, the knee is advanced until its face touches the log, and there it is held firmly in place by the dogs, adjusted by a hand-operated dog lever. The machinery is then set in motion, the carriage brings the log against the rapidly revolving saw, the sawed board drops off on the board roll and the carriage darts back to its original position as the block setter moves the log forward for the sawing of another line.

In the sawing or "breakdown" of the log, every log presents an individual problem as to the method of sawing to produce the maximum quantity and quality. The customary practice when sawing for

grade is to "saw around" the log. That is, the log is slabbed parallel to the bark line for several cuts, then the slabbed face of the log is turned against the knees and the same process repeated on the other side. The resulting cant is then turned face down, a slab removed, and boards cut parallel to the bark until the product is common grade. The cant is then turned over and sawed from the other side until the remaining cant is of the desired minimum thickness, depending on the species; this cant is then turned on its side and sliced into boards which are all as wide as the thickness of the cant.

Most portable mill operators, however, do not saw for grade. Their customary practice is to slab the log, slice off a few boards, turn the cant on its flat side and then finish sawing it without turning it. This is called "sawing alive," and takes no account of the grade of the lumber produced. Most uninformed operators saw their logs into inch lumber, the usual practice being to saw them about one-eighth of an inch plump as a margin of safety.

Maybe the mill operator has an edger to saw off the bark along the edges of the boards and reduce them to even widths, and a trimmer to saw off the rough ends and make the boards of standard length. If so, the boards pass from the saw to the edger and trimmer, and thence to the truck on which they are hauled away, or to the planing mill and dry kiln, if the mill has such equipment. The average portable sawmill, however, sells his output green from the saw—all grades, sizes and species mixed—to some wholesale concentration yard, and the lumber is hauled directly from the sawmill to the wholesaler's yard as soon as a truckload is accumulated.

The portable circular sawmill is the very antithesis of permanency. Anybody with a few hundred dollars can buy a small circular mill (maybe secondhand) and a power plant of some kind (perhaps the engine of a junked automobile) and set himself up as a lumber manufacturer. He can operate here today and there tomorrow; and the next day can shut down his mill and go back to farming or get a job somewhere at regular wages. This is shoestring sawmilling at its lowest ebb of efficiency and responsibility. Such a mill may be called a "peckerwood," "ground-hog," "ground-rattler" or "coffeepot"—but it manufactures lumber.

From this low level there are succeeding gradations upward. There are thousands of circular sawmills in operation by responsible, capable lumber manufacturers who are established on a more or less perma-

nent basis. They know what they are doing and make good lumber. No one of them is very large, but the combined output of their mills is large and important.

A principal drawback to the efficient operation of a circular sawmill is the fact that the blades of the saw are so thick and waste such a large part of the log in sawdust. Some of these circular saws take a saw kerf of as much as a five-sixteenths of an inch, and before long the mill may be obscured from view by the mounting pile of sawdust. Some wit has described such wasteful mills as "sawdust factories, with a by-product of lumber," which is an exaggeration, but not such a tremendous exaggeration at that. One of the numerous advantages of the band saw is its thinner kerf, added to which is the increased volume of production.

The building of a band mill requires the investment of thousands of dollars, and is not justified except where there is the assurance of an adequate long-time supply of timber or logs. That is why in spite of its advantages it has not crowded out the circular mill and why the great majority of all sawmills today are of the circular sort.

The band mill itself consists essentially of two large steel wheels around which the endless band saw revolves at high speed in the manner of a belt on pulleys. Most band mills are of the single-cutting type; that is, the saw has teeth on only one edge. Occasionally, however, there will be seen a double-cutting mill, equipped with a saw toothed on both edges, which slices a board off the log going and coming.

The band sawmill must be housed in a substantial structure on firm foundations, designed to keep the machinery in perfect alignment and withstand the stress and strain of the mill's operation. It is usually a two-storied structure, with perhaps a sort of penthouse above the head saw for the saw-filing equipment and storage of the saws. Machinery used in the actual production of the lumber—the head saw, edgers, trimmers and gang saws and resaws (if any)—is on the second floor of the mill. On the ground floor will be found the shafting, refuse conveyers, steam cylinders for the operation of the log-handling equipment, etc. Usually the power plant—the boilers and engines—is housed in a separate building, close to the sawmill plant but sufficiently separated to reduce the fire hazard. Power to drive the mill machinery is transmitted by belting from the engine to the mill's main shaft which runs the length of the mill building

below the second floor. Fuel for the boilers is generally supplied by the waste from the sawmill—sawdust and the slabs and edgings which have been ground up into small pieces by the "hog"—conveyed to the boiler room by chain conveyers or blowers. In some plants the slabs and edgings are merely cut into convenient lengths and fed into the firebox by hand as needed.

The machinery necessary to the operation of a band sawmill is elaborate and complex in the simplest form, and increases in quantity and complexity with the increase in the plant's capacity and elaboration of product. The mill itself is the heart of the operation. It consists of a sturdy base and frame upon which the two wheels are mounted, and is so placed that the upper wheel is above and the lower wheel below the second floor of the plant. The power to drive the saw is applied to the lower wheel by means of the shaft on which it is hung, this wheel being equipped with a heavy rim which acts in the nature of a flywheel.

Saw carriages used in connection with band mills are built on the same basic principles as those used on circular mills, but are larger, heavier, and have more elaborate equipment designed to contribute to precise and efficient production. The drive or feed is most frequently of the steam-piston variety, commonly known as a "shotgun feed."

The fact that band mills are two-storied affairs introduces into their operation the problem of getting the logs from the ground up to the sawing floor, and this is solved in a variety of ways. At some plants the reserve log supply is stored in a large pond adjacent to the mill, from which the logs are hauled up to the log deck in the mill by an endless jack chain, operating in a V-shaped trough known as the log haul-up. This jack chain, equipped at intervals of several feet with steel cleats called log dogs, has its lower end beneath the surface of the water in the pond. When the pondmen push the logs with pike poles onto the chain they are caught by the dogs and hauled up to the log deck where they are held, a few at a time, in reserve for placing on the carriage.

Band mills which do not have a pond but keep their log supply piled on the ground, generally have some type of derrick which lifts the logs as desired onto a jack chain or loads them on small cars or buggies which are hauled up an incline into the mill by a steam-operated cable.

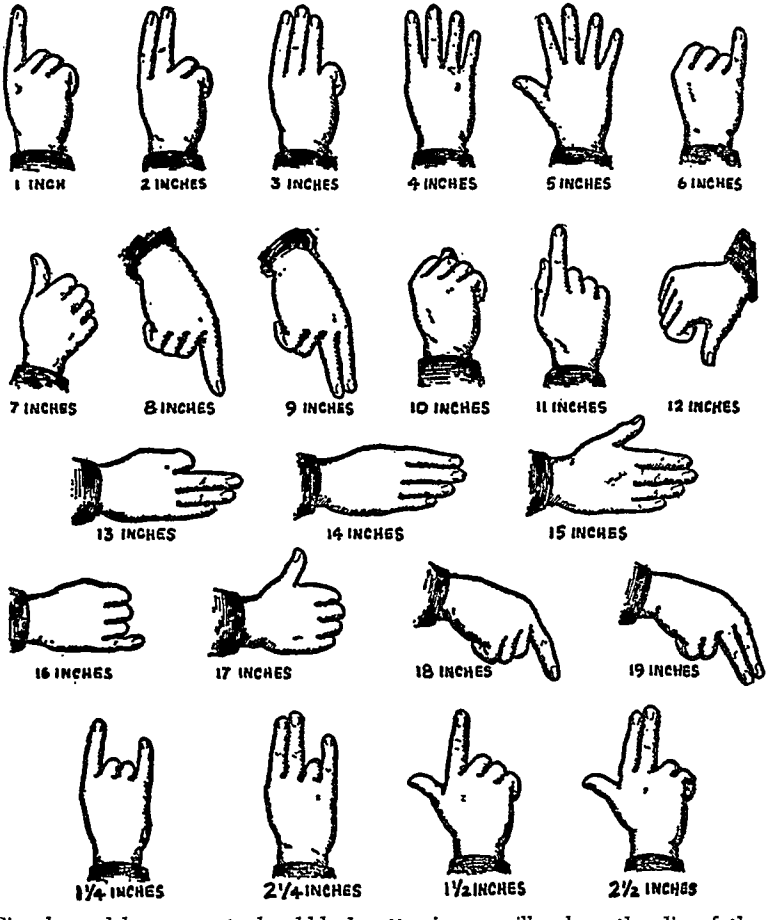
Some lumber operators bring their timber from the woods to the mill in tree lengths or in lengths longer than the standard logs. Such mills are equipped with some form of power saws either on the ground, in the pond or on the log deck to reduce the material to log lengths.

Band mills usually handle larger and heavier logs than portable mills, and the problem of manipulating the logs on the deck and carriage is correspondingly more difficult. In answer to the need a system of ingenious mechanical devices has been evolved, devices operated by steam pistons beneath the log deck, which makes it possible to handle the heaviest logs with the greatest of ease. First there is the kicker, which does just what its name indicates: it kicks the log out of the conveyer trough onto the log deck. The log deck is floored with skids, inclined in the direction of the carriage, and at the lower edge of the deck there are heavy steel log stops which protrude above its surface and hold the logs on the deck until needed. The log stop, also actuated by steam pistons, releases the log and helps push it on the carriage when the preceding log has been sawed.

The turning of the log on the carriage is accomplished by means of another ingenious and powerful steam-driven device known as a steam nigger. It consists of a heavy steel bar, equipped with hinged steel teeth, which by manipulation of the control levers may be caused to plunge up vertically from beneath the sawing floor and move the log in any of three directions—forward, backward and vertically. Guided by the sawyer, the powerful nigger tosses the log about like a jackstraw until it is in the proper position on the carriage and may be secured there by the dogger. This indispensable appliance was invented by William E. Hill, of Kalamazoo, Michigan, and is generally known as a "Hill nigger." For handling the large logs sawed on the Pacific coast there is a somewhat similar device known as a log turner. It is equipped with a hooked arm which reaches over and pulls the log or half-sawed cant off the carriage onto the deck, whence it is pushed back on the carriage by three or more powerful shover arms. These log-turning devices are controlled by a lever operated by the sawyer, and despite the weight of the logs and the heavy nature of the machinery, the operation is accompanied by a dexterity and facility which invariably arouses the wonder and admiration of visitors to a sawmill plant.

The sawyer is the key man of the sawmill operation. He is the

most skilled of the skilled labor, and he commands a wage rate commensurate with his skill and the importance of the work he has to do. The proper placing of the log on the carriage is only the first of his duties. Almost instantaneously and automatically he must size up the log to be sawed, appraise its defects—visible and hidden—and decide on the method to be used in sawing it. After taking off the first slab and sawing one or two lines he gets a better view of the inside of the log, and then he can begin to figure how to get the



Signals used by sawyer to head-block setter in sawmill, where the din of the mill's operation makes conversation impractical. (There are other variable signals used locally in various lumber producing regions.)

maximum quantity and grade out of it. This problem is complicated by the fact that he generally starts the day with cutting orders from the main office, telling him what sizes and grades are most desired. As the log carriage swishes back and forth and the band saw bites its whining way through the wood he must make up his mind when to turn the log, how thick to make the next cut, etc. His judgment as to the thickness of the cut is communicated to the head-block setter by means of a complicated system of signaling with his fingers —the din making oral communication impracticable—and the setter moves the blocks forward as the carriage sweeps back after the line is sawed.

Sometimes it is desirable to "quartersaw" the log—generally for the purpose of developing the unusual figure produced by this process. Oak and mahogany are the species most commonly quartersawed, to bring out the beauty of their grain. There are other reasons, however, for quartersawing these and other woods. Such lumber, because of the more uniformly distributed division of its surface between summerwood and the softer springwood, wears more evenly than plain-sawed lumber, it does not surface-check so readily, it is less permeable to liquids and shows less shrinking, swelling and warping than plain-sawed lumber. When softwoods are quartersawed they are known as "edge-grain" or "vertical-grain."

A perfectly quartersawed board is one which has one edge at the growth center of the tree and the other at the bark. This is for the purpose of splitting the medullary rays, seen as fine white lines on the end of an actual log but shown on the accompanying diagram by radiating black lines. The medullary rays are horizontal strips of food-storing cells which extend radially through the wood toward the bark. Some of the lines are very minute and others are two inches or more in width from edge to edge up and down in the tree. They waver slightly from a true radial course. Hence the effect of cutting a truly quartersawed surface on an oak board is to cause these rays to dip in and out of the plane of the saw and appear, as they do in the diagram, in broad, light-colored flakes and patches. This is the prized figure of the quartersawed oak.

In actual practice it would be wasteful of time and material to turn a log after sawing each board and thus make all boards truly quartersawed. The smaller diagram shows how, in the common method of quartersawing, logs are halved lengthwise and then suc-

cessive eighths are made into material which is more or less quarter-sawed by turning the log after sawing each eighth.

The lower board of the diagram is plain-sawed. In cutting plain-sawed lumber all boards are cut with their faces tangent to the annual rings. As a result, the medullary rays pass through most of the plain-sawed boards almost perpendicular to the faces and are seen only

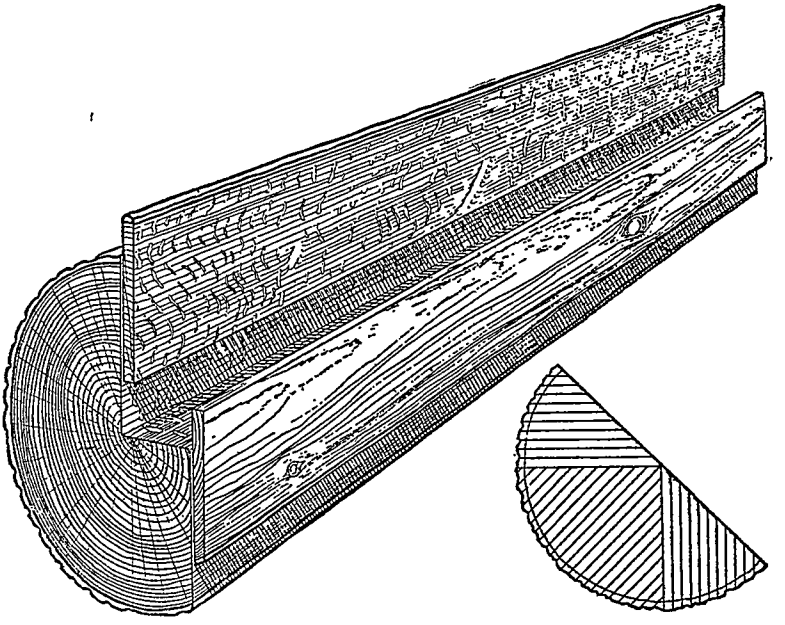


Diagram showing difference between plain-sawed and quartersawed lumber, and the method of quartersawing. (*Forest Service.*)

as very fine, narrow streaks which form an insignificant part of the grain.

As the boards fall from the log after passing by the saw, they are eased down onto the live rollers by the off-bearer, and by the live rollers they are conveyed automatically to the edger. This is a machine equipped with a number of small, movable circular saws, by means of which the wane (the bark edge) or other defects may be trimmed from the boards or wide boards may be cut into narrower ones if desired. From the edger the boards may go to the trimmer,

which squares off the ends of the boards into standard lengths, saws defective ends off boards, or reduces long boards to shorter ones. In its simplest form the trimmer consists of a table equipped with endless chains which carry the boards by an array of two or three movable cut-off saws. In a mill of larger capacity, the trimmer may have a battery of such cut-off saws arranged at intervals of two feet, making it possible to trim boards rapidly to any desired length. Some of the larger mills use overhead trimmer saws, which are suspended with counterweights and are dropped down upon the passing boards by the trimmer operator who sits in a perch above the conveyer chains and controls the saws with a keyboard not unlike that of a piano.

Emerging from the trimmer, which is the last operation within the mill proper, the lumber passes out on an arrangement of long, slowly moving endless conveyer chains under a shed, called the "green chain" or "slip," where a trained inspector quickly and skillfully examines each board and with a crayon marks its grade on it. If it is a hardwood mill (and in some softwood mills) the output of the mill most likely is air-dried, so the boards are lifted off the slip and arranged on buggies or dollies according to species, grade and thickness. If it is a large softwood mill the conveyer chains will carry the lumber, at least the upper grades, to the dry kilns, where it is stacked on kiln trucks according to thickness, and graded after it is dried. The standard old-fashioned method of conveying the loaded dollies from the green chain to the yard was by mule power; but in recent years small tractors have been used for this purpose to an increasing extent. In many modern plants the lumber is handled in unit stacks by lift trucks, straddle trucks or overhead cranes.

Lumber as it comes from the saw is soaking wet—"green" is the trade name for it. Except in unusual instances, the lumber buyer cannot use green lumber. He wants it properly seasoned, and seasoning by either air-drying or kiln-drying is an essential part of the lumber manufacturing process. In general, it is customary to air-dry hardwoods and to kiln-dry softwoods; although an increasing number of hardwood mills are now equipped with dry kilns and most softwood mills still air-dry their lower-grade stock. Kiln-drying, of course, involves a greater outlay of money for plant equipment and an immediately apparent increase in the production cost. Air-drying, on the other hand, takes longer—as long as a year to the inch in thick cypress—and is subject to greater degrade by exposure to the weather.

In a well-conducted lumber operation the process of air-drying is by no means as haphazard as it might appear to the casual observer. Yards are laid out according to scientific principles to attain the best possible circulation of air and drainage and otherwise to expedite the drying process and at the same time keep degrade down to a minimum. The stacks are arranged in straight rows along roadways or alleys laid out at right angles, and space is left between the piles at regular intervals so as to insure an unimpeded circulation of air in all directions. One of the commonest causes of degrading in seasoning is sap staining, and most manufacturers now prevent this by dipping their freshly cut boards into a chemical solution which prevents the stain-forming fungus from developing in the sapwood. An essential feature of good air-drying practice is to see that each pile is on substantial, rigid foundations, so graduated in height as to give the pile a slight slope to the rear for proper drainage. The boards are arranged to leave vertical air spaces or "flues" to facilitate the circulation of air. It is important to see that the stacking sticks or "stickers" separating the layers of boards are regularly and properly arranged, being sure to have enough stickers to hold the boards flat and straight. The front stickers overhang the ends of the boards to protect them from the elements. Time and money expended in proper piling is recognized as a good investment, and proper piling has been facilitated by the increasing use of straddle and lift trucks.

The length of time required for seasoning lumber by the air-drying process depends entirely on the species and thickness of the lumber, the conditions under which it is dried—and just what is implied by the use of the word "dry." Of late years there is a growing tendency on the part of buyers to specify the maximum permissible moisture content of the lumber they buy, which moisture content can be ascertained by instruments now available for that purpose. There is still an inclination to use such terms as "shipping dry," "bone dry," "air dry," etc.—all of which are more or less meaningless. In general, such hardwoods as oak and gum, under favorable conditions, will dry down to a moisture content of around 15 percent in ninety days. Softwoods will take less time than that in the spring and summer, but longer in the winter. Inch redwood on the Pacific Coast may take five or six months to dry down to a moisture content of 20 percent. Cypress dries even more slowly.

The use of dry kilns in the seasoning of lumber dates back to the

late seventies, when a pine manufacturer in Virginia first began to experiment with the drying of his lumber by artificial process. The earliest form of dry kiln in use in the lumber industry was the so-called smoke kiln. This incredibly crude and inefficient device consisted of a square, boxlike structure in which there was a platform six or eight feet from the ground. The lumber to be dried was piled on the platform and a fire was built on the ground underneath. The heat from the fire—also the sparks, smoke and cinders—was drawn upward through the lumber by a flue in the roof and thus the moisture content of the wood was more or less reduced. The smoke kiln was very uncertain and unreliable in its effectiveness. About the only thing about a smoke kiln which could be depended on was the assurance that, sooner or later, it would set fire to the lumber and probably burn down the entire operation.

One of the earliest experiments in kiln-drying lumber by use of steam was at the plant of John Stephenson and Company of New York City, manufacturers of horsecars. At the outbreak of the War Between the States this company was given a contract for making gun carriages, caissons and limbers. A large stock of thick dry oak was kept on hand by the Government for the manufacture of such equipment, but the abnormally heavy demand occasioned by wartime needs soon exhausted this supply, and there was no dry oak of the proper dimensions—some of it nine inches thick—obtainable on the open market. The artillery officers emphatically rejected the suggestion that green lumber might be used, so the Stephenson company set to work experimenting with the use of heat and steam for artificial seasoning. Their first experiments resulted in ruining the wood so treated, but eventually they were able to work out a drying schedule which removed four hundred pounds of water from a ton of green oak in three or four days, a remarkable achievement at that time.

Since such a crude and primitive beginning, the art of kiln-drying lumber has progressed steadily until today it is an exact science. Modern kilns have automatic devices for regulating both temperature and humidity, exact drying schedules have been worked out for all species and types of material, and kiln operators have achieved a degree of skill in turning out accurately dried lumber, with a minimum of degrade, which would have been thought impossible a few years ago.

There are various types of dry kilns on the market, and changes

and improvements in the details of their operation are made from time to time. Fundamentally, however, they all have the same objective: to reduce the lumber to a desired moisture content by mechanical means. The essentials of an effective dry kiln are relatively simple: proper air circulation, control of humidity and control of temperature.

Circulation of the air is provided in modern kilns by mechanically operated fans, which keep the air moving at a relatively low velocity. In the first kilns used in this country the matter of humidity control was overlooked, the principal consideration in those days being rapidity of drying. It is now recognized, however, that in order to prevent degrade of the lumber in the kiln it is desirable to maintain and control the humidity, and this is generally accomplished by the introduction of live steam, controlled by a thermostat. The heat used in dry kilns is conveyed by means of steam pipes from the mill boiler. Various systems of arrangement of the piping are used, and the temperature may be controlled either by hand-operated valves or by thermostats.

Modern kilns make use of instruments which not only show and record kiln temperatures and humidity, but also provide full automatic control of both. Their use not only effects great savings in operating costs, but also eliminates all guesswork or rule-of-thumb procedure, and produces perfectly seasoned lumber. Kiln-drying is now practiced with an exactitude which makes it possible for an operator to dry inch pine boards or thick walnut gunstock blanks to any desired degree without injury or degrade. In fact, lumber dried by a skillful operator in a modern kiln is more dependably and accurately seasoned than could ever be possible by any system of air-drying.

Commercial dry kilns in use today have various individual features and selling points, but they all operate on the same broad, basic principles. A few years ago a new and revolutionary method of drying wood by high-frequency radio waves was introduced experimentally. This is similar to the diathermy apparatus or "fever machine" used in hospitals for inducing interior heat in sore muscles and joints. The theory of this system of drying is that the radio waves cause the wood molecules to spin around at such a high rate of speed as to generate by internal friction a high degree of internal heat which quickly dries the wood. Experimental machines have produced in-

teresting results, although the practicability and economy of such a system in commercial drying of lumber has not yet been established and no drying equipment of this nature is in actual use.

It must be borne in mind that lumber as it comes from the sawmill is rough. Before it is suitable to most uses it must be made smooth by planing or dressing. In hardwoods this is generally left to the factory which buys lumber for its product. Most buyers of softwood lumber want it smooth rather than rough, and the stock is generally dressed at the point of shipment—by the mill or by the concentration yard if it is small-mill stock.

Carpenters since the time of the building of King Solomon's temple have accomplished the job of making rough boards smooth by the familiar process of dressing each individual piece of lumber with a hand plane. But in 1828 an old carpenter, William Woodworth, living in Poughkeepsie, New York, grew tired of this backbreaking task and invented a machine to do the work for him. Thus was the planing mill born. Woodworth was a better carpenter and inventor than promoter, and during the original term of his patent, fourteen years, he did little to develop it. In 1842 he had the patent extended for another seven years and within a short while he disposed of it to some promoters who improved and marketed the planing mill to their great profit. They would not sell the machines outright, but licensed them on a royalty of three dollars per thousand feet of all lumber dressed on them; and also set a price of seven dollars per thousand feet for custom dressing by those mills which were licensed operators of the machines. This planing monopoly was extended by a special Act of Congress in 1849; but was at last terminated in 1856, after which the manufacture of planing-mill machinery was undertaken by a number of individuals and firms. Under the sharp spur of competition there has been developed the marvelously efficient equipment in use today, by means of which rough boards from the sawmill are rapidly and accurately worked into any desired size and pattern of dressed stock.

The planing-mill department of a modern lumber manufacturing operation is equipped with machinery to surface boards, dimension stock and timbers, as well as to produce material cut to pattern, such as flooring, siding, ceiling, etc. The standard item of planing-mill equipment is the planer and matcher, of which the mill may have

one or several, depending on the volume of its production. This machine handles stock up to two inches in thickness, and may be used either to dress material on one, two or all four sides, or by means of a profile attachment produce varied types of pattern stock, such as flooring, ceiling, partition, casing, base, siding, etc. There are various stages of elaboration of the planing-mill equipment. If a mill cuts timbers it will probably have a heavy-duty planing machine called a timber sizer, which will dress all four sides of timbers as large as twenty by thirty inches. The mill may have a molder, which is a sort of smaller and lighter edition of the planer and matcher; and it may or may not have a resaw for the remanufacture of thick lumber, ripsaws, cutoff saws, etc.

Nowadays many sawmills are going into the production of finished or semifinished wooden parts for boxes, furniture, etc., and such operations as this are usually carried on as an adjunct to the planing mill, necessitating the installation of additional woodworking machinery, such as lathes, shapers and sanders.

Chapter VIII

ALLIED FOREST PRODUCTS

ONLY 69 percent of the total annual removal of saw timber is accounted for by the manufacture of lumber. The balance of the annual "drain," aside from the loss from fire, insects and disease, goes into the manufacture of those other products which use wood as a raw material but are not properly classified as lumber. These are veneers and plywood, cooperage stock, naval stores and many other similar products—all closely related to lumber but not lumber. They are roughly grouped with lumber as "forest products industries," and to that extent they should have consideration in any treatment of the lumber business.

Veneers and Plywood

No development during recent years has done so much to direct public attention to the products of the forest as the tremendously increased use of plywoods and veneers. World War II brought plywood prominently to the forefront as a material for use in the manufacture of airplanes and in war workers' housing—to say nothing of bathtubs, garbage cans and countless other things—and these new uses created a widespread impression that it is some sort of new and extraordinary material. The fact is that "the art of producing and using veneers dates back to the earliest days of civilization, and it may be looked upon even as a standard human development, since efficient veneering has always followed in the wake of human progress"—this on no less authority than the *Encyclopaedia Britannica.*

The use of veneers and plywood has been referred to as "a modern art three thousand five hundred years old," and this is probably a conservative estimate of its age. Authorities agree that veneered panels can be traced back to the days of the Pharaohs in Egypt. When Mr. Howard Carter a few years ago explored the tomb of Tutankhamen he brought to light some beautiful specimens of veneered furniture of which the most efficient modern cabinetmaker might well be proud. There was, for example, the handsome bed-

stead of the king's grandparents, with its headpiece veneered with laburnum wood and inlaid with gold and precious stones. A sarcophagus from a royal tomb of the Third Dynasty shows sides of six-ply, glued-up panels still as sound as when they were made more than three thousand years ago. No, veneers and plywood are not modern discoveries by any means, although some of their modern uses are decidedly novel.

A psychological obstacle with which veneers and veneered furniture have had to contend is the unfortunate connotation of inferiority which the word "veneer" took on in the public mind several years ago. When we speak of someone's "thin veneer of culture" we convey the idea that he is putting on a false front. Similarly, many people have a subconscious feeling that the use of "veneered" in connection with furniture necessarily implies inferiority as compared with that which is "solid." The fact is, however, that some of the great furniture masterpieces of all time have been specimens of the art of veneering. In the Louvre may be seen what is, perhaps, the most famous single piece of furniture in the world: the "Cabinet of the King," made for Louis XV by Jean Henry Riesener, a master craftsman of his time. It cost more than a million francs, and nine years' time was consumed in its production; but the time and money spent on it were well invested, as its beauty attests. After more than two centuries, it is still in a perfect state of preservation—a masterpiece of the veneering art. The master designers of later years—Hepplewhite and Sheraton and Duncan Phyfe—all wrought their masterpieces in veneer, and by its use were able to achieve effects impossible with solid wood.

There came a time, it is true, when the ideals of the early masters were temporarily forgotten. There was a span of several years, back around the turn of the century, when a great deal of distinctly shoddy veneered furniture was turned out. Inevitably the public came to associate veneers with sham and false pretense. Now, however, the pendulum of public opinion has swung back from this extreme. Today it is generally recognized without dispute that veneers add beauty, without detracting from quality, to our finest furniture and that veneers glued up into plywood produce a material of apparently unlimited adaptability.

What is veneer? Webster defines it as "a thin sheet of material: especially a thin layer of wood cut or sawed from a log." According to

the American Lumber Standards, "lumber of thickness not in excess of one-quarter inch to be used for veneering is classified as veneer."

There are several different kinds of veneers, classified by the way they are made and the use to which they are to be put. There are three different classifications of the product itself: face veneers; commercial veneers; and veneers for packaging and boxing. Face veneers, as the name indicates, are veneers cut from the popular cabinet woods, which are generally figured, and designed for the face of panels in furniture and fancy cabinetwork. Commercial veneers are those intended for "utility" purposes, where appearance is not the prime consideration. The other type of veneer is that for lightweight boxes and crates, such as egg cases and vegetable hampers.

Three basic types of manufacturing methods produce veneers: sawed, sliced and rotary-cut. The manufacturing processes employed vary with the type of the product. Practically all the commercial veneers and those used in boxes and crates are rotary-cut. On the other hand, most of the face veneers are either sliced or sawed.

The rotary-cutting lathe is the most economical and efficient method of manufacturing a log into veneers. It is used in producing some face veneers (not those with the fancy figures desired for matched panels) and is the method employed in making practically all commercial veneers. Rotary cutting is best adapted to logs which are straight, sound and large in diameter—known in the trade as "peelers."

In rotary-cutting hardwood veneers the log is prepared for cutting by being soaked or steamed until it is soft and easy to cut, but in the Douglas fir field all peeling is now done "cold"—without either soaking or steaming. The log, hot or cold, is mounted in strong chucks between two centers and revolved against a knife running the whole length of the log. The knife is set according to the thickness of the veneer required, and by means of a gear from the main drive is fed toward the center of the revolving log. The veneer rolls off the cutting edge of the knife in the shape of a long, thin sheet of wood the width of the length of the log, and as it comes from the lathe it bears a strong resemblance to the unrolling of a large roll of thick paper. The long sheet of wood is carried off on a conveyer table equipped with guillotine knives or clippers by means of which the veneer is cut into the desired widths.

The face-veneer industry is about as fascinating and romantic a

business as can be imagined. It involves the use not only of our popular native cabinet woods such as walnut and oak, but also the old-time favorite, mahogany, and a large number of other foreign cabinet woods, the very names of which are redolent of romance and far-away places. There are rosewood, lacewood, teak, primavera, padouk, tigerwood, satinwood, gaboon, madrone—a long list of them, ranging from amaranth to zebrawood, their points of origin stretching around the globe and carrying the veneer log buyer into strange and inaccessible places.

Logs to be made into veneers on the slicer—slicing being the commonest method used in making face veneers—are prepared by being split open by a saw, stripped of their bark, and then subjected to a moistening and softening treatment by being soaked in hot water or steam. The prepared portion of the log, called a flitch, is fixed horizontally in a heavy, movable frame which brings it down against the cutting edge of a long, stationary knife which shaves off veneers of the desired thickness—the standard American thickness being one-twenty-eighth of an inch.

Some woods, such as oak, which do not lend themselves readily to the slicing process, are manufactured into veneers by a thin-bladed saw, either band or circular, generally the latter. Flitches for sawed veneers are generally in the shape of large squared sections of the log, selected for grain and figure.

There is a modification of rotary cutting called the "half round" or "back cut," particularly adapted to cutting face veneers from walnut stumps which have been cut through the heart. The stump section is placed off center so that as it rotates it comes into contact only when the projecting portion reaches the blade. This makes it possible to cut from the heart toward the circumference and produces some unusual and attractive types of figure; also it is possible by this method to get wider veneers than by cutting on the slicer.

The manufacturers of face veneers have shown a wonderful ingenuity in developing the widest imaginable range of beautiful figure from the same species of wood, indeed from the same tree. The figure is determined very largely by the part of the tree from which it is cut, there being four major sections used for veneer.

The first, and most widely used, of these is the trunk of the tree, the veneers from which are called "longwood" in the trade. Longwood veneer may show numerous variations in appearance due to

irregular grain. If the grain is wavy it may be called curly or fiddleback. If it is interwoven, it produces stripe, rope or mottle figure. Other variations in grain develop varieties of veneer known as bird's eye, blister or plum pudding.

Then there is "stumpwood," which shows the twisted and irregular—but highly attractive—grain characteristic of the stump or base of the tree. "Crotch" veneer is cut from that section of the tree just below where it forks; there the fibers of the wood have been crushed and twisted between the two limbs, with the result that the grain is distinctively different. A "burl" is a deformed, wartlike growth of indeterminate origin which on the side of a tree gives an unusual and exceptional figure highly prized for ornamental cabinetwork.

Plywood is defined by Webster as "wood made up of an odd number of veneer sheets glued together, the grains of the layers being (usually) at right angles to one another." The Douglas Fir Plywood Association, which represents the manufacturers of the preponderant part of all the commercial plywood, has a somewhat more elaborate definition: "Douglas fir plywood is a built-up board of laminated veneers in which the grain of each piece is at right angles to the one adjacent to it. The kiln-dried veneer is united under high pressure with a bonding agent, making the joints as strong as or stronger than the wood itself. The alternating direction of the grain with each contiguous layer of wood equalizes the strains and in this way minimizes shrinkage and warping of the product and prevents splitting." A plywood board may be built up of three, five or whatever number of sheets of veneer is required to produce the thickness or rigidity desired. The center ply is called the core; the outside sheets are called faces—or face and back. If there are more than three plies, the sheets between the core and faces are called crossbands.

This method of building up the plies of wood so that each ply on one side of the central core is matched by a similar and parallel ply on the opposite side is a sound engineering principle known as "balanced construction." Built up in this way, plywood has very little tendency to expand or contract and also offers great resistance to splitting or checking, the outstanding strength properties of wood being developed to their maximum advantage. Plywood's strength is equalized in all directions, giving it a high degree of rigidity in large sheets. In fact, weight for weight, plywood is stronger than steel.

Plywood's resistance to splitting is particularly noticeable. This enables it to withstand the use of nails or screws close to its edges without damage, which gives it a wide range of structural possibilities.

Manufacture of plywood in the United States has found its greatest single manifestation in the Douglas fir region of the Pacific Northwest, where its development has been simply astonishing. In 1905 there was but a single small plant in this region making fir plywood and use of the material was restricted almost entirely to door panels. By 1929 the industry had expanded to a total annual production of 358,000,000 square feet. During the depression production fell off nearly 50 percent, but in 1932 it started back upward again and today there are in operation in Washington and Oregon 61 plywood plants which in 1950 made a total of 2,400,000,000 square feet of Douglas fir plywood.

There are two types of this plywood: exterior and moisture-resistant.

The exterior type, as defined in the United States Commercial Standards, "represents the ultimate in moisture resistance, a plywood that will retain its original form and strength when repeatedly wet and dried and otherwise subjected to the elements, and suitable for permanent exterior use." In the vernacular of the user, this exterior type is "a tough baby." In testing it literally goes through "hell and high water." Samples from factory-glued panels are boiled for four hours, dried twenty hours and then boiled four hours more. They are then subjected to a splitting test, and the glue joint must be stronger than the wood itself.

The moisture-resistant type, according to the Standards, "represents the majority of production and consists of plywood with a high degree of moisture resistance where its application requires that it shall retain its original form and practically all its strength when occasionally subjected to a thorough wetting and subsequent normal drying; a plywood suitable for construction where subjected to occasional deposits of moisture by condensation through walls or leakage or from other sources."

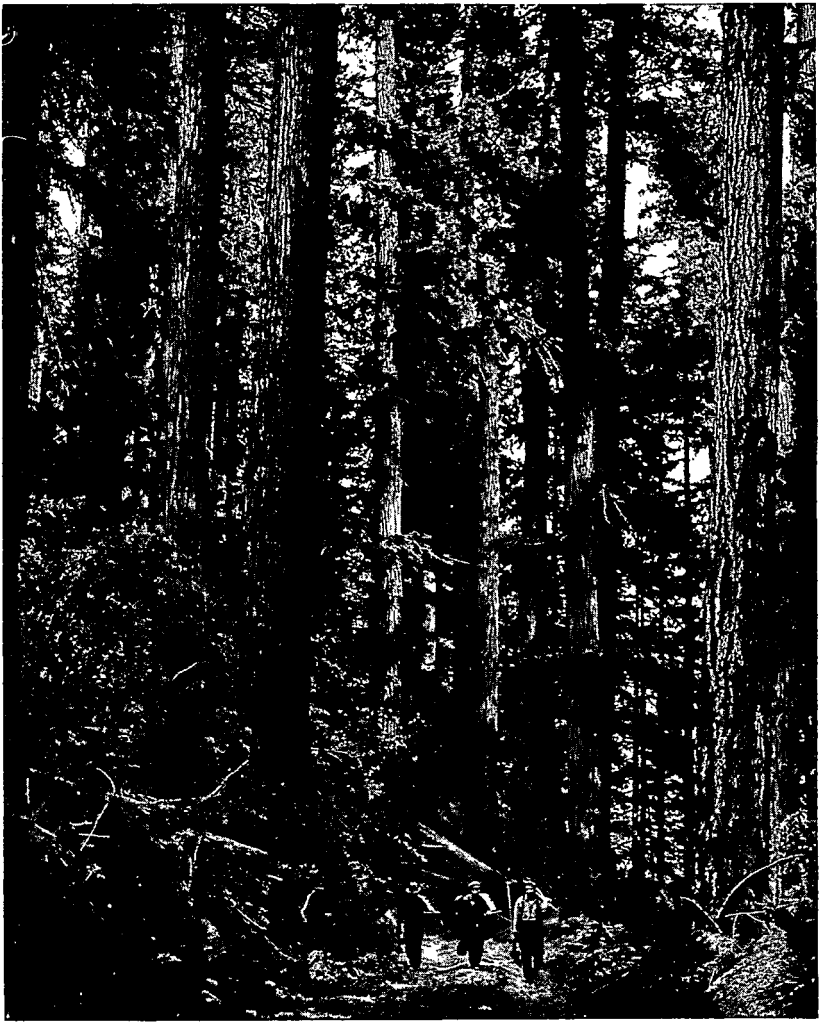
From the standpoint of quantity production, plywood made of softwoods—mostly Douglas fir—exceeds all other varieties in total output. There is, however, a large hardwood-plywood industry, and its production in 1950 amounted to more than a million square feet. "Hardwood plywood," says the Department of Commerce in one of

its publications, "is the cabinetmaker's mainstay, the furniture designer's stand-by, the decorator's ally, and the architect's and builder's prop. . . . Wherever wide surfaces, either flat or curved, are used on fine furniture, plywood yields excellent results without sacrifice of durability or beauty. In the furniture industry, hardwood plywood is indispensable. The paneled walls used so effectively in office buildings, hotel lobbies and other public places are generally of hardwood plywood, as are the cabinets, counters and showcases in our modern stores."

Hardwood plywood differs from that made of softwood in that it is generally faced with a veneer of some figured or fancy cabinet wood and is used for decorative rather than utilitarian purposes. Large quantities of hardwood plywood, however, are manufactured with a face of plain wood for uses where strength rather than appearance is the prime consideration, such as packing cases and the unseen insides of furniture. Another difference between hardwood and softwood plywood is that in hardwood panels the core is frequently a thick piece of lumber rather than a strip of veneer.

General methods pursued in the production of all types of commercial plywood, regardless of species, are similar. The first step, after veneer comes off the lathe and is cut into desired sizes by the clipper machine, consists in drying it down to the proper degree of moisture content by sending it on a slow trip on conveyer chains through a long veneer drier. The temperature in the drier is maintained at about 350 degrees, with air blown in and out through ducts which carry off the evaporated moisture. In from six to twenty minutes, depending on the thickness of the veneer, the wood is dried down to about two or three-percent moisture, and is cooled to 80 degrees before it leaves the driers.

Having been properly dried, the sheets of veneer are now ready to be glued together into panels. There has been rapid advance in the development of adhesives during recent years, and various types of glue are used in gluing up plywood panels. Generally speaking, however, some synthetic resin glues are used for the "exterior" or waterproof type of plywood, and protein glues for the "interior" or moisture-resistant types. Glue is applied to sheets of veneer by a spreader, a device consisting of large metal rollers which distribute glue on the face of the sheets as they are fed into the machine. Dry sheets of veneer are then placed on either side of the glue-surfaced

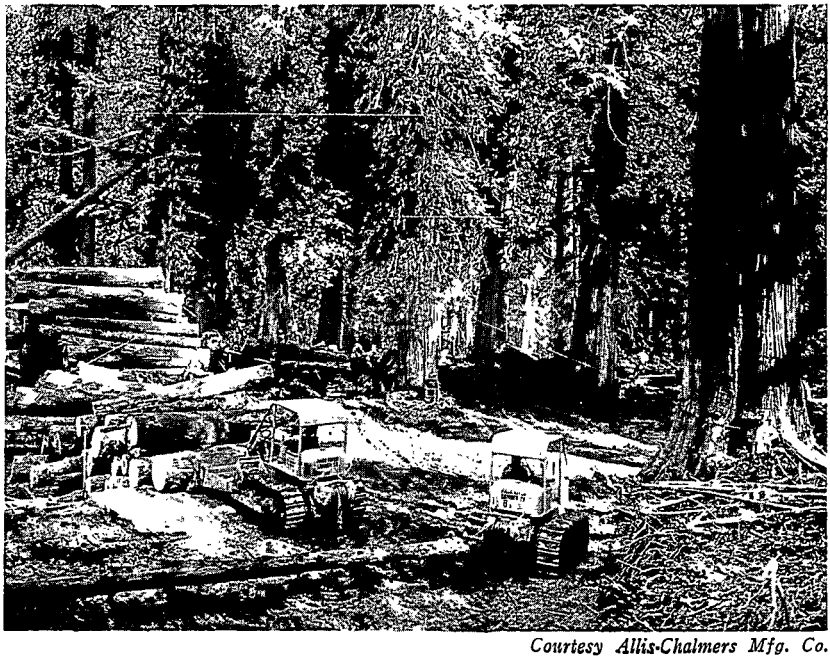


TYPICAL OLD-GROWTH DOUGLAS FIR TIMBER

A falling crew returning from work in the great Douglas fir forest of the West.



CATERPILLAR TRACTOR HAULING SOUTHERN PINE LOGS ON EIGHT-WHEEL WAGON



Courtesy Allis-Chalmers Mfg. Co.

TRACTOR LOGGING IN THE PACIFIC NORTHWEST

sheet, at right angles to the grain. This assembly makes a three-ply board; if thicker panels are desired, additional sheets of dry veneer produce five-ply, seven-ply or nine-ply. The prepared panel assemblies are then ready for the glue press.

A basic fact which has been known to the woodworking trades throughout the ages is that pressure is required to make a good glue joint. Even with all the modern types of glue, the fact has remained that it is impossible to make a good joint without firmly holding together the members that are being glued.

The early Egyptian workers in veneered panels used bags of hot sand or heavy heated stones to accomplish this. In later centuries the hand clamp was used, still later the mechanical clamp and then the hydraulic press.

Modern plywood is glued by means of either a cold-plate or a hot-plate press, the names being self-descriptive. For a long time most manufacturers of softwood plywood used the cold-plate process, which generally employs the fluid type of glues, the press holding plies together until the glue dries. Nowadays, however, more and more of the manufacturers are using the hot-plate presses. Development of the resin adhesives has tended to popularize the hot-press method, which sets glue more quickly and lends itself to faster production.

The moisture-resistant type of plywood is made by either the cold-press or hot-plate process. Exterior plywood is made altogether by the hot-press process, with synthetic resin adhesives which are set within a few minutes by the giant presses. Pressure and heat change the resin glue into an insoluble plastic, driving it into the pores of the wood and welding the cross-laminated veneers into large, rigid units in which the glue joint is stronger than the wood itself.

Recently there has been a revolutionary new development in plywood production: the use of high-frequency, electrostatic heating equipment for bonding the veneers. This equipment utilizes the principle of generating heat within a mass by exposing it to a high-frequency field which sets up molecular friction uniformly throughout the material. Those who use it say that it gives the advantage of the cold-press method—simplicity of loading and unloading and flexibility of panel construction—plus the operating economies obtained with the hot-plate method.

The list of plywood's uses is long and interesting. Someone has

summarized them as "everything from boxes to boxcars, from window displays to movie sets, from boutonnieres to bridges, from chicken coops to defense housing and from toys to airplanes." Almost every day some new use is found for this valuable and versatile material, the war having added tremendously to the gamut.

One of the most notable was the development of the plywood airplane during World War II. Devised originally as a trainer plane, to release scarce strategic metals for the manufacture of combat craft, the plastic bonded plywood plane came to stand on its own merits and was manufactured in large quantities for service on the fighting front. The famous British "Mosquito" bomber, then the fastest thing in the air, was a plywood plane. Colonel Edward S. Evans, aviation and transportation authority, stated publicly that plywood is better than metal for airplanes, pointing out, among other things, that elimination of rivets gives greater speed and greater fuel economy. During the war immense quantities of plywood were used in the construction of airplanes and gliders.

Another outstanding use of plywood in the waging of World War II was in the plywood lifeboat. Skillful naval architects designed a boat built of plywood strips laid up diagonally in molds, which not only saved a ton of steel on each boat but was almost a half-ton lighter than the steel boat. Furthermore, the plywood boat when loaded to capacity remains twenty-one inches above the water, as compared with fourteen inches above water for its steel equivalent.

An incidental wartime use which required a large amount of this versatile material was in the manufacture of foot lockers for the Army. The locker is in reality a sort of trunk in which each soldier stores his clothes while in barracks. It stays at the foot of his bed—whence its name. Each locker requires 25 feet of plywood—and the Army ordered five million of them at one time.

Other wartime uses included cargo vessels, mine sweepers, the famous, hard-hitting PT boat, landing boats, bulkheads and built-in parts for coastal patrol and torpedo boats, assault boats, demountable pontoon bridges, barracks, insulated "hutments" for the tropics or the Arctic regions, aircraft hangars and wartime housing.

In the field of prefabricated housing plywood saw one of its most spectacular wartime developments. The big four by eight-foot panels are easy to handle and can be used for exterior walls, sheathing, flooring and interior paneling. Millions upon millions of feet of plywood

went into war housing, especially on the West Coast; and since the war plywood has gained increasing favor with home builders in all sections of the country.

The most recent development in the plywood field is the "Unicel" boxcar. Made entirely of plywood it is much lighter—and, its makers say, much stronger—than the standard steel car.

Plywood is the young mammoth of the forest-products industries. It is a meritorious, adaptable material. It has been effectively publicized and merchandised; it has popular appeal. Already it is a big industry; apparently it is destined to be much bigger.

Cooperage

"Cooperage" is a term to include all types of wooden containers which are manufactured or assembled from staves and heading. It includes barrels, kegs, hogsheads, casks, tubs, pails, buckets, kits and tierces. In the trade are two distinct divisions, known as "tight" and "slack" cooperage, the distinguishing characteristic being the ability of the "tight" containers to hold liquids without leaking. Such commodities as whisky, rum, beer, ale, molasses, sirup, milk, vinegar, pickles, olives, kraut, pork, lard, oils, grease, turpentine, paint and chemicals are shipped in tight barrels. Tight tubs and pails are for butter, lard, jelly, pickles, fish, etc. Slack barrels and kegs are for the shipment of some fruits and vegetables, meats, rosin, china and glassware, dry chemicals, tobacco, nails, small hardware and machine parts —and, until a few years ago, flour and crackers.

The barrel has been a useful adjunct to civilization for many centuries. It was in use by the Romans as far back as the early Christian era and was known and used even at the time of the building of King Solomon's temple. It is an ingenious contrivance, based on a scientific principle of design whereby every part braces and strengthens the others. Each stave is a keystone to the arch, and the "bilge" or outward curve of the staves not only adds to the strength of the structure but also facilitates its movement by rolling on its side. Whatever prehistoric, natural-born engineer designed and manufactured the first barrel made a valuable and lasting contribution to humanity.

Naturally enough, the beginning of the cooperage industry in America was coincident with the first settlements, and barrels, hogsheads, casks and tierces figured prominently in the cargoes of vessels

leaving our ports in the seventeenth century. The earliest settlers soon discovered that the New World's white oak was admirably adapted to the manufacture of staves for the wine casks or "pipes" used by the vintners of France and Spain, and many an American pioneer eked out his livelihood as he cleared and cultivated his land by selecting the best of the white oak trees for riving into pipe staves —generally the "Double Extra" or "Red Dot," which was 60 inches long, 1½ inches thick, and from 5 to 6 inches wide, free of sap. When Andrew Jackson was, among his other enterprises, operating a frontier store and trading post on the banks of the Cumberland River around 1800, he did a thriving business in trading the hides, furs, beeswax and other native products of the backwoods for iron and nails and manufactured goods from the East. Prominent in the cargoes which he shipped by flatboat down to New Orleans were pipe staves for export to France, and it is not impossible that some of these staves made the return trip to the Tennessee back country, as Old Hickory made a practice of keeping a pipe of Madeira in the cellar of the Hermitage for the entertainment and refreshment of his guests.

Those days of hand-rived staves have passed, along with the other forms of primitive handicraft upon which our modern industry is founded. Now staves are manufactured on modern, scientifically designed machinery—drum saws, jointers, etc.—and the barrel of today is a product of which any woodworker may well be proud.

There are three well-defined steps in the production of any type of cooperage. First, there is the felling of the tree in the forest and cutting the trunk into short logs or "bolts" of required length. The next step is manufacture of the staves and heading from these bolts. Then comes assembling of the finished barrel from the component parts: staves, heading and hoops. In early days the hoops were generally of wood, elm being the ideal species. Today the steel hoop has almost entirely supplanted the wooden. The heading and the staves are generally considered two separate kinds of business in the cooperage trade, as the manufacturing processes and materials involved are entirely dissimilar. Assembly plants are usually established at points near the distillery, vinegar works, fruit warehouse, or wherever the barrel is to be used. They are furnished with a setting-up form, into which the required number of staves is placed, a windlass for forcing the staves together, a crozer for making the groove into which the heading fits, bung borers, and other incidental equipment.

The universally preferred wood for high-quality tight cooperage is still white oak, on account of its lack of porosity. Red oak, treated to close its cells, is sometimes used; but white oak is the favorite. Other hardwoods employed are birch, beech, maple and red gum; occasionally such softwoods as Southern pine, Douglas fir and spruce also are used to some extent. In 1947 oak provided 88 percent of the wood for tight cooperage, with gum the next in importance, supplying 6 percent of the total.

Of the total, more than one-half (by value) is in the tight cooperage classification. Tight barrel staves are officially graded into a number of subdivisions: bourbon, alcohol, wine, oil, turpentine, Cuban, pork, gum, etc. Staves for beer barrels are set up in still another classification, for which the grades are less exacting. In common practice, the stave manufacturers usually refer to the high-grade staves for whisky barrels, as "whisky" or "bourbon," with an intermediate grade of "beer" or "ale." The low-grade staves are generally classified as "oil"—although they may be used as well for molasses or any other liquid product than the spirituous beverages.

The tight-cooperage business dwindled away to a shadow of its former self during Prohibition days, but recovered rapidly when the Prohibition Amendment was repealed. A complicating factor was soon introduced into the tight-cooperage industry, however, by the Treasury Department's "Regulation No. 5," which specified that "in the case of American-type whiskies produced on or after July 1, 1936, other than corn whisky, straight corn whisky, blended corn whisky, and blends of straight corn whisky, 'age' means the period during which the whisky has been kept in charred *new* oak containers." The inclusion of that word "new" in the regulation upset both the distillers and the cooperage manufacturers. Since the memory of distillers runneth not to the contrary, the white oak barrel with charred interior had been recognized as the most acceptable method of aging whisky. It was the practice of the trade to use these charred barrels over and over as long as they were in serviceable condition. The requirement of new barrels upset this established practice, necessitated the production of a greatly increased number of new white oak whisky barrels every year (with a correspondingly increased drain on the white-oak timber supply), and created a new problem involving the utilization or disposal of the secondhand charred-oak barrels —a problem which has not yet been solved.

Although the white-oak barrel maintains its supremacy as the preferred container for aging whisky, its related product, the oak beer keg, has not been similarly fortunate. Since the repeal of Prohibition there has been a change in beer-drinking habits from prepro-hibition days, with a decline in the dispensing of draught beer and an increase in the sale of the bottled and canned product. Furthermore, the metal beer keg was introduced as a substitute for the old, familiar wooden keg. It is a brewing tradition that draught beer should be kept in a wooden keg; but the manufacturers of the metal containers, by aggressive merchandising, have gone a long way toward breaking the tradition down.

Although the most valuable tight barrels are used for whisky, 71 percent of the total production of tight barrels and kegs is used for "nonspirituous commodities," a classification which includes oil, sauerkraut, molasses, chemicals, pork, pickles, etc. Substitute containers for these have been making a steady inroad, and changes in shipping and merchandising methods have also reduced the use of barrels. In the case of oil alone, wooden barrels have been steadily declining in popularity as a shipping container, what with the growing use of pipe lines, tank cars, barges and ships, and metal drums. The trend to small containers made of glass or metal has also reduced the use of barrels for "nonspirituous commodities" other than oil.

The production of slack cooperage is in general similar to the process of making material for tight barrels. One difference is that slack barrel staves are frequently sliced rather than sawed, the bolts being prepared for the slicing by steaming or boiling. Woods used in manufacture of slack staves and heading need not be of as high quality as those used for tight barrels, except that in barrels for foods the wood must be one which does not impart odor, flavor or color. Gum, cottonwood, elm and hackberry are suitable for food containers; but softwoods are utilized for nonfood products such as rosin, tobacco and hardware.

The use of slack cooperage has been vitally affected also by the change in merchandising and transportation methods. Until the turn of the century such commodities as flour, sugar, cement and salt were universally shipped in slack barrels. Every crossroads grocery dispensed its stock of sugar, flour and salt from open barrels—not to mention the traditional cracker barrel—and large-scale users bought them in barrel lots. Today practically all these markets have been

lost by the slack barrel. Flour and sugar and salt and crackers are sold by sack and package, and there has been a steady decline in the production of slack cooperage material since the peak year of 1900. Today only 1.2 percent of the flour manufactured is shipped in barrels; and although the production of sugar has more than trebled since 1910, the market for sugar barrels has almost completely disappeared.

In the shipment of such commodities as fruits and vegetables, packing-house products, pottery, chinaware and glassware, the slack barrel has held its place better though it appears to be fighting a losing battle. Even in the case of rosin, produced in the heart of the forest, metal barrels are competing successfully with wooden containers which would seem, in this sphere at least, to have the inside track. The hogshead is still the favored shipping container for tobacco, although a substitute knockdown hogshead made of plywood is now competing with the traditional product. For the shipment of such things as nails, fish, small hardware and machinery parts, the slack barrel or keg is still popular, but other containers are actively competing. On the other hand, there are a few commodities that require increasing quantities of slack barrels. This group includes dry chemicals and dried milk, now being manufactured in larger and larger amounts. The barrel seems particularly well suited for them. More than seventy-five dry chemicals, from aluminum chloride to zinc oxide, are now shipped in wooden barrels, requiring about a million barrels a year. The production of dried milk has been progressing by tremendous leaps, greatly enhanced by the war, and about two million barrels are needed every year for this purpose.

Like all other industries, the cooperage business was strongly affected by the war. The abnormal wartime demand for steel brought notable changes. Competition of the steel drums had been forcing down the production of wooden barrels until the total output in 1941 was at the low point of about six million. The War Production Board, however, faced with the acute wartime shortage in steel, denied the use of steel drums to 160 different products late in 1942, and to supply these products with essential shipping containers asked the cooperage industry to produce 15 million wooden barrels during 1943. Meeting this emergency call for wooden barrels put a sudden and abnormal strain on the cooperage industry, but it supplied the nation's demands.

Looking to the future, the industry is availing itself of the benefits of research work through a campaign of investigation and study now being carried on by the Armour Research Foundation. This program is directed toward discovery of means of making better barrels, finding a satisfactory liner for barrels to hold vegetable oils, efficient closures for staves and heading, and the solution of similar problems. The cooperage industry is an old industry, but it has modern ideas.

Naval Stores

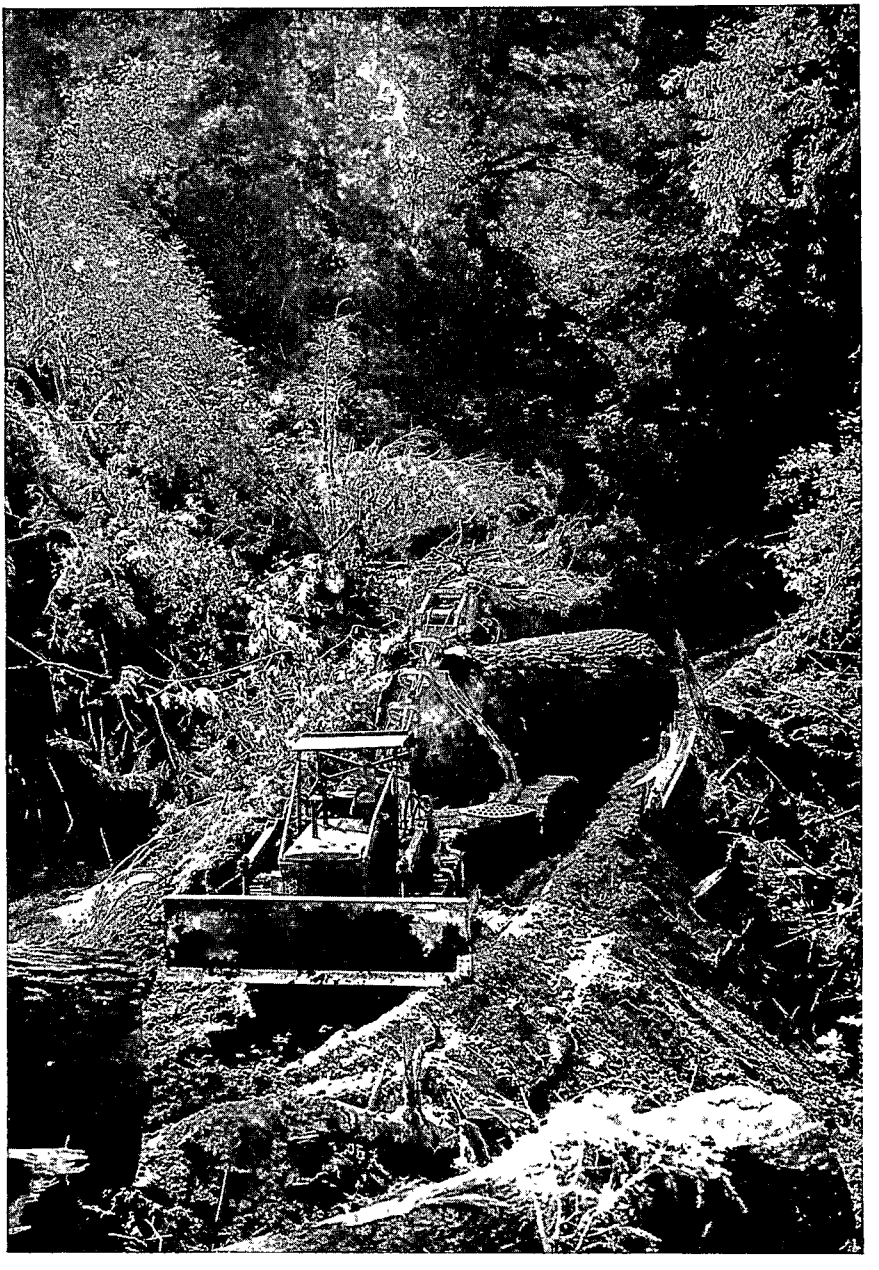
"Naval stores" is the trade name for rosin and turpentine. The significance of the maritime appellation may now be obscure, but it is honestly come by, since it dates back to the time when pine tar and pitch were essential for calking the seams of ships, and for tarring their ropes and sailors' pigtails. Sweden was originally the source for European navies, but tar and pitch were shipped back to England by Captain John Smith in 1608, and turpentine had been distilled by early French settlers in Nova Scotia even before that, in 1606. Nowadays, perhaps a little paradoxically, the Navy no longer uses naval stores; but turpentine and rosin have moved over into a new classification as raw material for a number of chemical and other essential commodities, and the demand for the pine tree product is even greater now than it was in the days of iron men and wooden ships. Naval stores are marketed in "units," a unit consisting of one 50-gallon barrel of turpentine and 1,400 pounds of rosin.

The gum from which turpentine is distilled is derived from the longleaf or slash pine by tapping the tree, in somewhat the same way rubber trees are tapped. A shallow V-shaped "streak," as it is called, is hacked into the trunk of the tree near its base, and from this streak gum slowly oozes into a metal or pottery cup attached to the tree below the gash. This gum is produced by resin ducts just inside the bark, which are particularly large in the longleaf and slash pines; and when the streak is cut it stimulates formation of other ducts immediately above it in the tree. Gum will normally flow from the open wound for about a week, though about two-thirds of the total flow comes in the first twenty-four hours. After a week a new streak must be cut just above the old one to induce new flow. At periodic intervals the gum is gathered and taken to the stills set up conveniently at near-by points. The flow falls off to practically nothing during cold



K. S. Brown Photo. Courtesy Weyerhaeuser Sales Company

FOUR STEPS IN RIGGING A SPAR TREE



BULLDOZER ATTACHMENT

With a bulldozer attachment, the logging tractor can be used for road building as well as logging.

weather, and the turpentine season extends only from March to November, with the peak in summer months.

Through the years there have been some minor changes and improvements in the method of chipping the face and gathering gum, but for the most part the business of producing naval stores is still conducted on a rather primitive basis. A typical turpentine camp will have centered about it not more than eight or ten crops—a "crop" being an arbitrary unit of woods operations, consisting of 10,000 cups or faces. The tract of timber being turpentined is often referred to as an "orchard."

The first chipping of trees is generally done in January, as it has been found that an early streak stimulates an early flow of gum. An ideal streak is generally not more than a half-inch high and about three-fourths of an inch deep, but this varies with the quality of the tree and the skill of the chipper. It has been found also that a sharp hack produces more gum than a dull one. The exposed side of the tree is known as a "face." When a face has grown so high that it cannot be reached with the customary hack and maul, it is extended with a long-handled, sharp-edged "puller." As the face extends up the tree the cups also are raised, to keep them as close as possible to the fresh streak and the gum flow.

The cup on an average face will fill in two or three weeks, and the product is gathered by a "dipper" who carries a bucket from tree to tree and empties cups into it. Buckets, when filled with the soft gum, called "dip," are emptied into barrels placed at convenient locations in the woods, and these barrels when filled are hauled by wagon or truck to the still.

Until a few years ago the typical average turpentine still was one with a capacity of eight or ten barrels of dip, consisting of a copper kettle over a brick firebox, with a copper worm or condensing coil attached. The dip, with water, is dumped into the kettle, the fire started, and the mixture brought to a temperature of 212 degrees, when distillation starts. Turpentine vapors are carried off into the worm and there condensed into the liquid distillate, which is drained off into barrels. This distillate is composed about half-and-half of water and spirits of turpentine, but the water, being heavier, sinks to the bottom of the barrel and is easily drained off, while the turpentine is dipped into barrels or conveyed into storage tanks. The mixture remaining in the kettle, after the spirits of turpentine are distilled out, is cooked

to a temperature of about 330 degrees, and then the liquid rosin is drawn off through strainers into vats and barrels where it is allowed to cool and harden.

Some of these primitive manufacturing plants still remain in operation, but today most of the naval stores are produced on modern steam kilns which are more efficient and more economical, because one of the steam stills has the capacity of five of the old-fashioned fire stills.

During recent years output of naval stores by the time-honored method of chipping the growing trees has been augmented by a new source of supply: the distillation of stumps and deadwood to be found in such abundance in the naval-stores belt of the South. The product is known as "wood" rosin and turpentine as distinguished from the "gum" product made from the living trees. The production of "wood" rosin and turpentine has grown steadily since the industry was launched in 1909, and it now constitutes a substantial part of the total naval-stores output of the country. Some experts state that wood turpentine is equal in all respects to gum turpentine, and maintain also that the wood rosin, although it darkens somewhat under high temperatures, is to be preferred to the gum because it is free from dirt and foreign matter. It appears, however, that despite the opinion of the experts, the "gum" product is still generally favored by most users.

The United States is now and for a long time has been the world's principal source of supply for naval stores, contributing more than 70 percent of the total consumed by the world. The industry is centered in the coastal plains of the South, where it employs more than 35,000 full-time workers and supports about 300,000 people. Savannah is the principal naval-stores market, other important centers being Jacksonville, Brunswick and Pensacola.

France occupies second place in naval-stores production. The industry there is especially interesting because it is based on artificially grown trees. The trees were planted in the Maritime Provinces by Napoleon to reclaim the barren waste of sandy land, and since they attained maturity they have supported a business which during peacetime contributed greatly to the prosperity of France. Portugal ranks next to France as a producer of rosin and turpentine, followed by Spain and Mexico.

Great Britain, having no naval-stores industry of its own, has

been the world's largest import market, annually consuming about 60,000 metric tons of rosin and 144,000 barrels of turpentine.

The war greatly multiplied demands for rosin and turpentine in this country, fully half of all produced going into war uses. In 1941 the naval-stores industry of the United States produced 285,000 units; in 1942 the producers were asked by the Government to step this up to 450,000 units. In 1950 the output was about two million drums (520-pound) of rosin and 673,000 barrels (50-gallon) of turpentine.

The output of naval stores has been greatly increased in recent years by the adoption of a new idea developed by the research scientists. It involves the principle of making two blades of grass grow where only one grew before—or, rather, making a turpentine face produce two cups of gum instead of one. That this could be done was demonstrated in some large-scale experiments carried on by the Southern Forest Experiment Station at Olustee, Florida, at first on a laboratory test basis and in 1942 on 160,000 trees. This discovery by Government scientists showed that the flow of gum could be increased by 50 percent, or possibly more, by the simple process of brushing or spraying a new-cut streak with sulphuric acid. Not only that, but the treated streak will continue to flow gum for two weeks instead of one, so that chipping needs to be done only half as often as before—an important factor when labor is scarce. The Experiment Station has been investigating also the possibilities of developing a strain of supertrees to produce an extra-high yield of gum. Cuttings have been taken from trees showing an abnormally high yield, and it is hoped that trees from these cuttings may show a yield of two or three times that of the run-of-the-woods trees. This, for the present at least, is no more than a vision; but the stimulation of gum by sulphuric-acid treatment has been proved beyond question, and the total output of naval stores has been greatly increased by its adoption.

With the tremendous strides in the chemical trades during the past few years, there have been some notable adjustments in the markets for naval stores as hundreds of new products and processes have been discovered in which turpentine and rosin can be utilized. In prewar times turpentine had been used principally for paints and varnish and in the manufacture of some chemicals and pharmaceutical goods. The leading uses for rosin were in the manufacture of paper, soap, chemicals and drugs, ester gum and synthetic resin, linoleums, adhesives and plastics.

Now modern research is making possible the use of naval stores as a base for new synthetic chemicals of widely varying application. One of the most interesting developments has been the use of turpentine in the manufacture of synthetic camphor. In former days all our camphor came from the Far East, principally from Formosa, but when this source of supply was cut off we quickly developed our synthetic industry to a point where we no longer need the natural product.

New types of synthetic resins made from rosin are finding a wide field of utilization, sometimes in surprising ways. For example, they are being mixed in roadway sub-bases. This prevents the earth from soaking up water and so opens new possibilities in the quick construction of emergency airfields and highways. New rosin derivatives are also being used to modify and plasticize asphalt, making it easier to handle and giving it greater penetration when used for roofing.

The great development of the chemical potentialities of naval stores lies in the future, and these are beginning to appear almost limitless. Some chemists have dubbed turpentine "the coal tar of the future," and so it may be. It has been only a few years since the chemists made commercially available such turpentine derivatives as isoprene and myrcene, which are of such great importance as factors in synthetic rubber production. The Baruch Report said: "If isoprene could be manufactured readily, it might well be the best raw material for the manufacture of synthetic rubber." Now isoprene can be manufactured readily from turpentine, and so can myrcene, dipentene and the whole line of so-called terpenes—hydrocarbons, alcohols and ketones. Turpentine may prove the wonder material of the chemical industry of tomorrow.

Paper and Pulp

None of the other forest-products industries has shown such astounding increase during the past twenty years as the paper and pulp business. In the decade from 1925 to 1934 the domestic annual output of pulp furnished only about 71 percent of the total pulp supply of the country, the remainder coming from imports. Within the next seven years the output of our pulp mills doubled, and in 1941 and 1942 they furnished 89 percent of the total supply. This growth has been paralleled by an increase in the manufacture of paper and

paperboard in the United States. The introduction of new and larger machines since 1920 has been an important factor, and has resulted in an increase in production to a total annual output of 19,157,208 tons in 1946 as compared with 3,106,696 tons in 1904.

A large part of this growth in the American paper-manufacturing business has been accounted for by its expansion in the South. Between 1935 and 1938 there were built in the South 15 new paper and pulp mills, which brought the total to 45, using about four million cords of wood each year. During the past ten years the number of mills in the South and their output have steadily increased, and in 1950 the 56 Southern mills consumed more than ten million cords of wood. Most of these mills are engaged in the production of kraft paper and paperboard, for which Southern pine is ideally suited, but there are also mills making book and machine-finished white paper. A newsprint mill in Texas was so successful that its capacity has been doubled since it was built a few years ago; and another newsprint mill has been built in Alabama. Since 1925 there has been a notable increase in pulp production also in Washington and Oregon, where the forests of spruce, fir and hemlock, together with the abundant water power, supply natural requisites for a successful industry.

Any attempt at a brief and yet comprehensive discussion of the paper industry is made difficult by the fact that there are numerous kinds of paper and five distinct processes of pulp manufacture. Paper can be grouped into six broad classes: newsprint; book paper—coated and uncoated; fine writing paper; paperboards; wrapping paper; and a miscellaneous group including a large number of grades such as tissues, absorbent papers, building papers, etc. These different kinds go into widely differing uses, and are produced by the different processes which convert wood into pulp: sulfite, sulfate, soda, mechanical and semichemical.

In the sulfite process the active pulping chemical is sulfurous acid and calcium bisulfite in solution. The pulpwood is brought to the pulp mill in short bolts, and converted into chips by a mechanical chipper. Chips are subjected to the chemical treatment in a steel digester lined with acidproof brick from eight to fifteen hours at a temperature of 320 degrees Fahrenheit. The pulp resultant after the cooking is washed, screened and compressed into large, thick sheets or "laps," which are then conveyed to the paper mill for use.

The sulfate process consists of cooking the chipped wood in the digesters with a liquor composed of caustic soda and sodium sulfide, and bringing the mixture to 350 degrees Fahrenheit temperature. This method is particularly well suited to pulping woods with such a high resinous content that they cannot be successfully pulped by the sulfite process.

In the soda process the noncellulose parts of the wood are reduced to soluble form by caustic soda. This is especially well adapted to pulping hardwoods, and produces a fiber which is soft, bulky and weak, suited to the manufacture of book and magazine paper.

In the semichemical process the chips are softened by chemical treatment and then reduced to pulp by mechanical action. Various chemical solutions are used, but they are mainly neutral or alkaline in character. The yield is high and the pulp is employed mostly in the manufacture of corrugating board and lower-grade wrappings.

The mechanical pulping process depends entirely on the mechanical transformation of the wood into fiber. Chemicals are seldom used, but sometimes the wood is steamed or boiled in water or a weak chemical solution before grinding. The bolts of wood are forced against a revolving grindstone, under a spray of water. This produces a "slush" of pulp which is pumped directly to the paper mill or compressed into laps for storage and transportation. Mechanical pulp is generally used for such cheap forms of paper as newsprint, and is so weak it must be mixed with a sulfite or a sulfate pulp before being made into paper.

The pulp and paper industry is one of huge proportions. It is now a five-billion-dollar industry and, from the standpoint of value added by manufacture, ranks sixth in the United States. The United States provides nearly half the world's paper and uses about half. Our per-capita consumption is nearly 250 pounds annually.

We are by far the largest users of newsprint but, strangely enough, newsprint accounts for only about four percent of our total paper production. Our newsprint mills are mostly in Maine, with a few in the Pacific Northwest and two in the South. Most of our newsprint comes from Canada, where its manufacture constitutes the Dominion's largest industry.

The growth of the paper industry in this country during recent years has raised in some people's minds the question whether the timber supply is sufficient to provide raw material for this and for all the

other forest-products industries. Theoretically, at least, it appears that there is potentially enough. In some regions, however, the competition between wood-using industries for the visible timber supply is already acute.

In the paper-producing countries of Europe, notably in Scandinavia, the paper business and the lumber business are conducted as integrated industries, both deriving their raw material from the same timber supply and thereby effecting the maximum utilization of the tree. In a few notable instances such integration is being successfully practiced in this country; but for the most part the paper mill and the sawmill, where they exist in the same region, are competitors when it comes to acquiring timber—a situation which does not make for conservation or efficient utilization.

Crossties

A tremendous amount of the timber cut in this country has gone into the manufacture of railroad crossties. This is one field in which the purveyors of substitutes for wood have made no headway. For years and years there have been experimentations with steel ties and concrete ties, but the outcome of all this has been the continuing supremacy of the wood tie. From the standpoint of resiliency there has been nothing to approach it; and, since the introduction of wood-preserving methods, there has been no criticism of its durability. The wood crosstie is still king in its realm.

The number of ties necessary to supply the railroads will be realized when it is considered that it takes about 3,000 ties to the mile of main-line track, with slightly fewer to the mile on sidetracks. The total number of ties on American railroads is now about one billion. An average replacement during the five years before 1942 was about 41 million per year, but in 1942 this was swelled to 65 million by the war emergency. For a number of years this annual replacement ran in excess of 100 million ties and as high as 140 million. Currently the rate of replacement is somewhat lower because of the greater life of the treated ties. Development of the art of wood preservation brought about a sharp reduction in tie renewals—from an average of more than 200 ties per mile in 1917 (and much greater previously) to 91 ties per mile in 1949.

Crossties have been standardized in three lengths: eight feet, eight

and one-half feet and nine feet, with eight-foot size preponderant. Switch ties are longer. Main-line ties are generally eight or nine inches wide and six or seven inches thick. Ties used on branch lines and spur tracks may be smaller.

There are two methods of manufacturing ties, sawing and hewing or splitting, and the sawed tie has been gaining rapidly in general adoption. Sawed ties are made on sawmills, frequently of the portable variety. The hewed and split ties are a product of hand labor in the woods, chopped or rived out of the tree trunk with ax and broadax. The tie hacker is an artist in his line, but his species is disappearing as the sawed tie slowly gains the ascendancy.

A very large proportion (over 96 percent) of all crossties; both sawed and hewn, are now subjected to a wood-preservative treatment —usually creosote—before being put into service. Out of 30,285,046 ties laid in 1949, 28,876,066 were treated. Both softwoods and hardwoods are used for tie production, varying with the region in which they are produced. The common practice is for railroads to buy their ties from producers on their lines. About 33 percent of all crossties are made of oak (both red and white), about 14 percent are Southern pine, 14 percent gum and 9 percent Douglas fir. These are the principal kinds of wood used, but all the following species are employed to some extent: ash, hickory, black locust, honey locust, walnut, cedar, cypress, hemlock, larch, spruce, beech, birch, cherry, gum, maple, chestnut, elm, hackberry, magnolia, mulberry, poplar, sassafras, sycamore, butternut and catalpa.

Shingles and Shakes

Wood shingles were once the almost universal roofing material in the United States, and some of our oldest buildings have roofs of this kind. During recent years their use has declined from the peak levels, but they are still popular, and about seven billion or more of them are used every year, not only for the roofs but for the side walls of homes.

Originally all shingles were hand-split or rived, but now most of them are sawed on machines. The riving process, however, continues in scattered places. This type of shingle is commonly called a "shake." There is a considerable production of shakes in the redwood country

of California. Some other Western woods, such as sugar pine and red cedar, are also split into shakes. Occasional small operators produce hand-split cypress shingles in the South, principally in Louisiana and Florida. To a limited extent throughout the South there is local use of hand-split hardwood shingles (locally called "boards"), usually made from some species of oak, preferably the *Quercus acuminata*, which goes by the common name of shingle oak because of its adaptability to this use. The total hand-rived production is small, and it is one of the last remaining vestiges of the old handicraft processes.

The first step in the manufacture of shakes is to select a suitable tree, one which appears to be straight-grained and therefore suited to riving. The tree is felled and sawed into short bolts cut to the desired length of the shingle. These bolts are then split into blocks, for facility in handling, and the blocks are laboriously split into the shakes. The principal, and unique, tool of the shake-river is the frow: a short, heavy steel blade a foot or less in length, with a short, stout handle attached at right angles to the blade and in the same plane with its edge. The frow is driven into the end of the block with a mallet or maul, its progress through the wood being expedited by the use of wedges. In some instances the shake, after being split, is drawn down to a thin feather-edge at one end with a drawknife, but sometimes it is used in its original condition, with uniform thickness throughout.

The first shingles used in the United States were made by hand in this manner. Later came the introduction of the shingle saw, and today the greatest part of the country's shingle production is by means of a highly mechanized, specialized—and localized—industry. There is still limited production of handmade cedar, cypress and pine shingles; but about 95 percent of the nation's total output is sawed from Western red cedar, and most of the shingle mills are in the states of Washington and Oregon and in British Columbia.

The modern shingle-sawing machine is an efficient high-speed piece of equipment, capable of producing a high-class product. All the shingles of commerce are of the thick-butt, thin-tip style, and they come in a wide variety of grades, depending on the presence or absence of defects, whether the shingle is flat-grain or edge-grain, etc. The best shingles are known as No. 1 and consist of those which are strictly clear, free from sap, and all edge-grain, 4 inches or greater

in width. In length they may be 16, 18 or 24 inches. The thickness is about ½ inch at the butt, and 1/16 or ⅛ inch at the tip.

Shingles are sold in bundles of approximately 250, and four bundles (1,000 shingles) are about enough to cover 100 square feet, or what is known in the shingle trade as a "square." Men who pack the bundles use an ingenious machine packer or buncher, and are called "shingle weavers." Some of them attain a remarkable degree of skill at their work.

High insurance rates and legislation adverse to wood construction have worked against the use of wood shingles, but during recent years the Red Cedar Shingle Bureau, through a constructive form of trade promotion, has done much to counteract this. They have pointed out that most fires originate in the interior of buildings and that underwriters' figures show that only a relatively small percentage of our fires are caused by sparks on shingle roofs. Furthermore, shingles made of the durable species of wood—cedar, cypress and redwood—will last approximately thirty years; and they have the advantage of being economical, light in weight and pleasing in appearance whether used as a roofing or a siding material.

Miscellaneous Forest Products

There are various lines of activity depending on the forest as the source of raw material which use the tree in its native state rather than as sawed lumber, but which increase the drain on the nation's forest resources.

Use of timber for poles and piling is very large, although exact figures are not available. It is estimated that about three million poles are used every year and perhaps as much or more piling. In early years the more durable species of wood were selected, but recently knowledge of the art of wood preserving has led to the widespread employment of creosoted or otherwise chemically treated material. In fact, most of the poles and piling are so treated, and untreated material is the exception.

One of the forest industries that takes a large amount of timber in the aggregate is the handle manufacturing business, the species being principally hickory and ash. The total value of handles made in the United States in a typical year will amount to nearly $15,000,000,

and about half of them are hickory. Ash is used for handles on a variety of tools where strength and lightness of weight are desirable, as in hoes or rakes. For striking-tool handles (hammers, axes and hatchets) hickory is recognized as the world's supreme wood. Incidentally, the United States has a monopoly on the supply of hickory; it grows native nowhere else in the world. So American hickory handles are shipped to all parts of the globe.

There was a time, not so long ago, when a large amount of hickory was used also to make spokes for wagon, buggy and automobile wheels, as well as golf sticks and other miscellaneous things. Steel has taken these markets almost entirely away from wood. Today the handle-maker is almost the only user of hickory in the wood industry, although there is a limited use of it for picker sticks in the textile business.

There is a small but important forest-products industry for whose objects no effective substitutes have ever been found, and that is the manufacture of those peculiarly hard, smooth, tough woods, dogwood and persimmon, into such things as golf-club heads, shuttle blocks, etc.

Excelsior is a small item—but it consumed 135,949 cords of wood in 1947. About 50 percent of this was cottonwood and 40 percent Southern pine—the rest basswood and other miscellaneous species.

A match is about the smallest piece of wood in common use, but we need a lot of matches. About 100 million feet of lumber goes to making matches every year, most of it white pine. Toothpicks are mostly made of birch, and use only a few million feet of wood per year.

Plastering lath are generally produced, principally in softwoods, as a side line at sawmills, and are made from the clear material reclaimed from slabs and edging strips. Lath are essentially a salvaging product, but in a year the industry will supply about 200 million lath, valued at close to $1,000,000.

Large quantities of bark are consumed in making tanning extracts, and in some species the wood itself is ground up and used as the source of the tanning acid. There is also a large and growing wood-distillation industry, using both hardwoods and softwoods, which removes a considerable amount of timber every year.

One of the greatest drains on the forest, and one which does not result in any manufactured product, is the wood taken for fuel. In

some regions this is waste from sawmills and other forest industries, but a very large quantity of timber is cut down every year for this reason. Estimates of wood for fuel run as high as 100,000,000 cords per year, which is roughly equivalent to 50 billion board feet—nearly twice the total current removal of timber for lumber.

Chapter IX

PRODUCTION AND DISTRIBUTION

Accent on Distribution

APART from its many essential allied industries, the lumber business in the nature of things has far-flung ramifications. Sawmills operate where trees grow; but lumber is used where people live and have their homes, factories and farms. This has resulted in a somewhat complex but efficient system which operates to produce the lumber and get it into the hands of the people who want it, no matter where the timber stands or where the people live.

The industry is made up of three well-defined classifications: manufacturers, wholesalers and retailers. The manufacturers produce the lumber; the wholesalers (and commission salesmen) help them sell it to retail yards or to industrial plants which use it as the raw material for their product; and the retail yards provide an outlet for lumber needed by the general public for construction and other purposes.

There are occasional overlappings and combinations of these three divisions. Some sawmill operators are also in the wholesale business, buying lumber from other mills, and may also operate a local retail lumber yard or a chain of yards for which they have to buy lumber and other building materials. A wholesaler not infrequently has an investment in a sawmill, and some are interested in retail yards too. Retail dealers occasionally have a financial interest in some sawmill, and may conduct a wholesale business besides. As a rule, however, every lumberman is basically classified as one or the other: a manufacturer, a wholesaler or a retail dealer.

The three branches of the industry are dependent on one another and generally recognize this interdependence. Each branch has its own peculiar problems, however, and these it works out through its own organizations and as a rule independently of the others. There is co-operation, but there is not the close tie-up between manufacturers and distributors that is found in some industries.

Lumber Manufacturing

To say that one branch of the lumber industry is more important than another would be to create a distinction which does not exist. It is a fact, however, that production is the foundation of the entire business and that the greatest investment is in this branch.

The distinguishing characteristic of lumber manufacturing is operation of a sawmill—and there are all sorts and conditions of sawmills. The great Weyerhaeuser Timber Company's mill in Longview, Washington, will produce a million and a half feet of lumber in a day —enough to build a thousand small homes. There are many little portable sawmills scattered over the country which will not produce that much in five years. But the lowliest of operators is justified in claiming the title of "lumber manufacturer" just the same as the big producer on the West Coast. Between these two extremes are thousands of other sawmill operators, some larger than others, some very sizable, some not so big—but all of them, from the largest to the smallest, saw logs into lumber and that is what makes a man a lumber manufacturer.

To cite some figures, the 1947 Census gave a total of 53,109 active sawmills in the United States. Of these only 496 reported an annual output of 10 million feet or more; they furnished about 13 billion feet of lumber, or about 37 percent of the total. The other 52,613 mills combined to supply the other 63 percent.

Aside from mere matter of size, there are numerous other characteristics which differentiate one sawmill operator from another and which intensify or individualize his problems. One major classification is that which divides the lumber manufacturers into timber-owning mills and those which own no timber but buy their logs from outside sources.

The timber-owning mill operator has the advantage of an assured supply of logs of known variety and quality. He can adapt his mill operation to his logging operations, and vice versa. He can, by pursuing advanced forest-management practices, adjust his production to the increment of his timber and thus insure the perpetuity of his business. Balanced against those advantages is the disadvantage of having a necessarily large investment tied up in a supply of raw material when there is no assurance of a future profitable market. There

are problems of interest and taxation and forest fires and the various other difficulties which dog the timber owner.

The non-timber-owning mill operator, although he avoids these troubles, has plenty of his own. He lives on a sort of hand-to-mouth basis as to log supply, which is highly unsatisfactory and not conducive to making any long-term plans. On the West Coast he may buy his logs in the open markets or from the National Forests; in other producing regions he may buy occasionally from the National Forests, but more often from farmers or from the owners of small near-by timber tracts. Either basis of operation has elements of hazard and uncertainty which the timber-owning mill does not have to face.

Independent of their size or their method of operation, mills in different sections have problems peculiar to their own regions which they share with one another but not with the manufacturers in other sections. These are problems of transportation, markets, legislation and labor conditions. The sawmill operator in Oregon has problems and so has the manufacturer in Maine or in Tennessee—but, in most cases, they are not the same. On the other hand, there are certain underlying factors that affect lumber manufacturers in all sections, such as Federal legislation and regulation, the threat of competitive materials, etc., in which all have a common interest.

Outside of such occasional and rather casual binding ties, however, the lumber manufacturers of the country are entirely independent, individually and regionally. They are fiercely competitive when it comes to marketing their products, and a numerical majority of those engaged take no part in any form of co-operative effort and bear no part of the burden of its expense. The very nature of the business causes those in it to live in remote and isolated places, and this helps develop a "lone wolf" tendency.

For a number of years the lumber-manufacturing industry was a nomadic enterprise. A manufacturer acquired a tract of timber, set up a sawmill, cut all the timber in sight and moved on to some other locality. Recurrent waves of such migrations can be traced from the Atlantic seaboard to the Pacific Coast. But when the Pacific Coast was reached manufacturers began to realize that they had arrived at the last frontier—that there was no supply of timber just beyond the horizon. This has caused a new sort of thinking to develop among them: they are now, in increasing numbers, studying the problem of stabilizing their business through the pursuit of forestry practices

which will tend to perpetuate their timber supply and through trade-promotion activities which will sustain the markets for lumber and other forest products. Manufacturers of today are not planning to cut out and move on; they are planning to stay where they are.

Today, as was pointed out in the first chapter, the lumber manufacturing business of the United States is very largely centered in two sections: the West and the South. In recent years these two regions have been producing about 90 percent of all the country's lumber, about evenly divided between the two, with the remaining 10 percent of mill output spread on about an even basis among the other producing sections: the Northeast, the Lake States and the Central States.

The Wholesaler

The average sawmill operator is essentially a manufacturer, not a merchandiser. To some extent this is due to the fact that for a good many years he did not need to be a merchandiser. During the years when the United States was growing and filling up its new portions with settlers, the demand for lumber was steady and insistent. All the sawmill man had to do was to make it; there was always somebody waiting to buy it. This condition changed several decades ago, but it took lumber manufacturers a long time to realize that it had changed. The industry grew up in the old pattern when lumber sold itself, and many of the manufacturers found it difficult to shift their methods with the changing times. Merchandising is still the weakest spot in the industry's armor.

Today nearly all the larger lumber manufacturing companies maintain sales departments to dispose of their output, but a major part of the smaller mill operators depend entirely on the wholesale lumbermen to do their selling, and many of the big mills also depend on them somewhat. Just how large a portion of the total lumber output is sold through wholesalers has never been definitely established. Some estimate it at 65 percent; others place the figure higher, up to 80 percent. At any rate, a very large part of the lumber produced in our sawmills moves to its ultimate markets through channels provided by the wholesale dealer. He is not merely a useful link in the chain of distribution; he is essential.

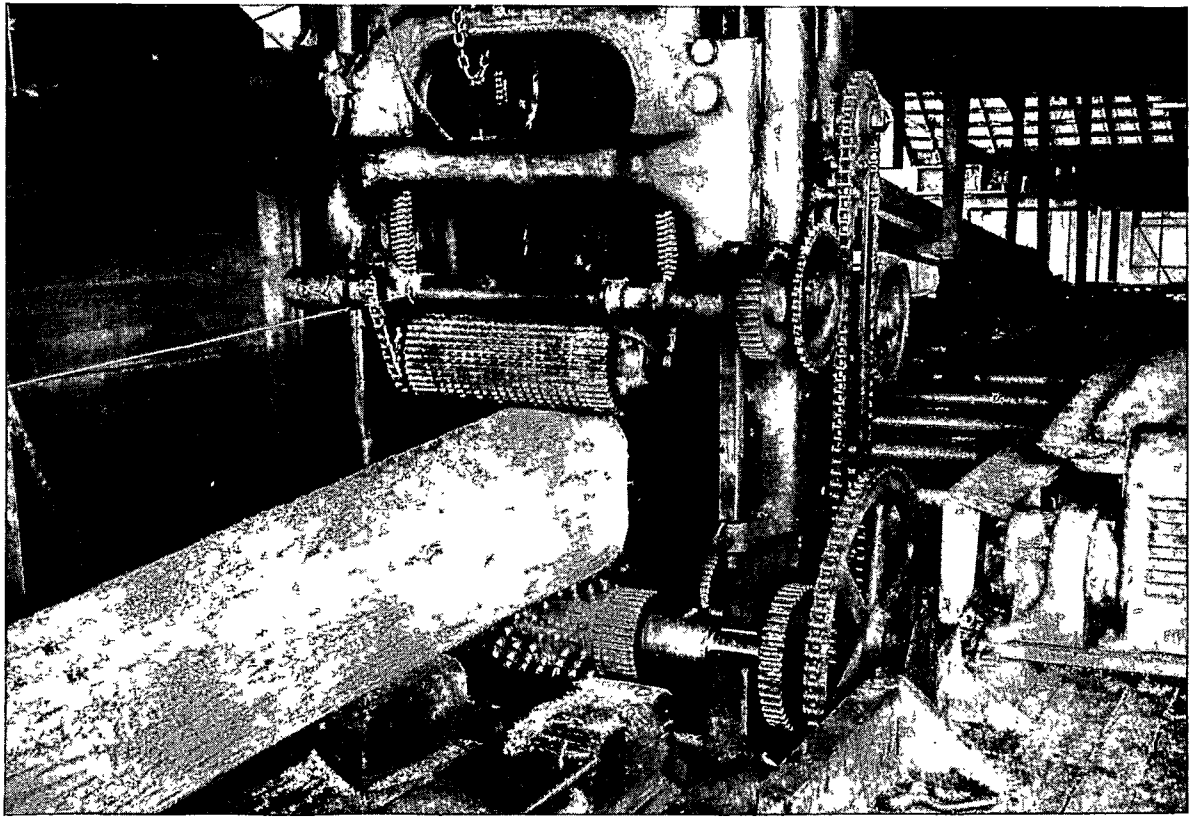
The Honorable Joseph E. Davies, later prominent in diplomatic circles, was the representative of the wholesale lumberman's organi-





K. S. Brown Photos

FOUR STEPS IN HANDLING THE LOGS



SWEDISH GANG MILL FOR SAWING LOGS. THE THIN SAW BLADES MAKE VERY LITTLE SAWDUST

zation when he was practicing law in Washington thirty years ago. He forcefully expressed the wholesaler's place in the modern scheme of things:

> The middleman—whether he be a wholesaler, jobber, commission man, manufacturer's agent or what not—came into existence to supply a definite need in our business system, and the fact that he is so important a factor in every industry under the most intense competition indicates the great social value of the service he renders. When we analyze the functions performed by the wholesaler in a basic industry such as the lumber industry and measure the economic value of them, it becames evident that the competitive system has created in the wholesalers of the country a vast and highly efficient agency of distribution.

The wholesale dealer has occupied a prominent place since the birth of the industry. At first he was the recognized outlet for the mills' production, and few manufacturers maintained sales departments of their own. Transportation then was principally by water, and wholesalers maintained their yards at such convenient centers as Albany, New York; Tonawanda, New York; Cleveland, Ohio; Chicago, Illinois; Norfolk, Virginia; and Baltimore, Maryland. The importance of these distributing centers began to dwindle as manufacturing regions supplying them reduced their timber and as railroad transportation developed and mills in the back country were enabled to reach customers. Wholesale yards in Chicago, for example, in the late seventies and early eighties bought and sold millions of feet of lumber every day. The river front at the fork of the Chicago River was crowded with lumber-laden windjammers from the Michigan and Wisconsin mills. As many as two hundred at a time were tied up there. The yards bulged with lumber. But as the Lake States mills began to fade and the timber of the South and West began to expand, the supreme importance of the Chicago yards declined correspondingly. Chicago is still an important wholesale center, drawing lumber of all species from the various producing regions, but it is only a shadow of what it was fifty years ago.

The wholesale lumber dealers of today may be roughly grouped into two classes, the "yard" wholesalers and the "office" wholesalers, the terms being practically self-explanatory. And there are two kinds of yard wholesalers: those who have concentration yards and those who operate distribution yards, the former class predominating.

The concentration yard is a particularly active and valuable factor in regions where there are large numbers of portable or peckerwood mills, as in the South. These mills, for the most part, are sawmill operators of the crudest type, and nothing more. They produce rough green lumber, in a variety of widths, lengths, grades and species. As soon as they have a truckload of it, most of them want to haul it somewhere and sell it for quick cash. The concentration yard provides a ready market for them—a market they would not otherwise have, as the retail yard and industrial buyers want carload lots of dry lumber, not a job lot. The operator of the concentration yard assembles and consolidates the output of numerous small mills in his locality. If he is dealing in pine or other softwoods he is equipped with a planing mill and dry kiln, so as to be able to sell dressed, dry lumber. If he is handling hardwoods he probably remanufactures the green lumber to some extent by edging or trimming it, sorts it as to species and grades, and stacks it on his yard for air-drying. The buyer can obtain from a concentration yard straight carload lots of lumber in desired sizes and grades, and the yard serves as an indispensable link between the producer and the buyer.

There are some wholesale concentration yards which specialize in a particular wood—ash for example. Ash does not grow in dense stands, but is generally found in scattered trees along with other species. Some of the largest hardwood mills may cut enough ash to sell straight cars of any desired sizes or grade, but most manufacturers merely accumulate mixed lots of various grades, lengths, widths and thicknesses and find it desirable to dispose of it in mixed cars to wholesale ash specialists who assemble the purchases on their yards and so can serve buyers of carload lots.

The operator of a wholesale distributing yard works on a somewhat different basis. He is generally located in some city or center of lumber consumption where there is a local demand for small—or large—lots for prompt shipment, perhaps by truck. The distributing yard buys carload lots of seasoned, well-manufactured stock from manufacturers of recognized standing, puts the lumber in stock and then sells it to his trade.

Some wholesale yards specialize in fancy cabinet woods, mostly of the imported species. These woods are bought by the user generally in limited quantities, perhaps only a small piece or two or three boards. There are a few fancy wood specialists who pride themselves

on being able to supply at least a limited quantity of practically any species that grows anywhere.

The direct mill shipping wholesaler operates no yard at all. He is a trader—sometimes a speculator. His principal stock in trade is his knowledge of markets and market conditions, his acquaintance with lumber buyers and their requirements and his familiarity with sources of supply. He is generally situated at some point in the consuming territory where he can keep in touch with the lumber buyers. The wholesaler who operates on a large scale maintains staffs of salesmen and buyers, traveling their respective territories, and a traffic department to expedite shipments from mill to destination.

In the pursuit of his vocation, the office wholesaler may take an order for a quantity of lumber to be delivered to a factory or retail yard at a fixed price, with the prospect of making his legitimate profit by buying it at a lower price from some mill. On the other hand, he may buy a quantity from some manufacturer in the expectation of selling it for more than he paid. Then, again, he may finance some impecunious manufacturer and sell all his output; or he may have a contract with one or more manufacturers who have no selling organizations to dispose of their output on a percentage basis of remuneration as sales are made. Some wholesalers merely solicit orders from lumber buyers and then turn them over, at the same price, to a manufacturer who has the stock, collecting a functional discount, usually eight percent, from the mill.

Another group of specialists in the wholesale trade are those engaged in the exportation of American lumber to foreign countries. These merchandising experts have acquired by experience a knowledge of foreign markets, the kinds of lumber desired there, and the manufacturers in this country producing them. The export trade has attractive features and many manufacturers like to ship their lumber abroad. It is, however, an intricate and complex business, involving familiarity with banking, shipping, insurance and other factors besides lumber, and so the manufacturer may find it most satisfactory to conduct it through export specialists. Since World War II the exports of American lumber have greatly diminished, and this branch of the trade has been relatively inactive.

Aside from his knowledge of markets, and his provision of a ready outlet for the mills' production, one of the wholesaler's principal services to the manufacturer is in the way of financing. The small lumber

manufacturer (not to mention some of the larger ones) seems to be chronically underfinanced, and many of them could not operate at all if they were not provided with cash advances by the wholesaler. Even when he does not make advances, the wholesaler may take the millman's lumber on an f.o.b. mill basis, and pay cash for it when shipped, or at least pay a substantial part of the invoice and assume the credit risk. On the other hand, it may be necessary for the wholesale dealer to extend credit accommodation to the retail yard or factory to which he sells the lumber. In short, the wholesaler provides a financial cushion between the shipper and the buyer, a service which is not merely helpful but frequently essential to the transaction.

Wholesale lumber dealers have taken a particularly active part in the intercoastal trade from the West Coast mills to the Eastern markets. A large part of this business has always been handled through them, and without them this trade could never have been developed. Many of the tidewater mills on the West Coast were built without any facilities for seasoning their stock; they simply loaded their lumber, as it was cut, into an intercoastal vessel, started it on its way and trusted to some energetic and resourceful wholesaler to sell it before it reached its destination.

At times in past years there was a similar practice with mills selling to the interior trade, not only in the West but also in the South. Mills operating on the quick-liquidation basis, which necessitated full-time operation regardless of market conditions, made a practice of loading their lumber on cars and starting it rolling in the general direction of the available markets, trusting to their wholesaler connections to sell it for them while it was in transit. Many wholesalers specialized in these "transit cars," and they led a feverish existence as they frantically tried to dispose of the cars as fast as the mills could load them. The transit car was, of course, a demoralizing influence on the lumber market, as the pressure to sell frequently resulted in a reckless cutting of prices. During recent years, however, this evil has about disappeared. Mills now are generally not operating under such stress as to necessitate high-pressure selling, and the transit-car wholesaler is now little more than a memory.

The wholesaler has fared best in the past when conditions were fairly normal. He was almost legislated out of existence during World War I when the War Industries Board threatened to eliminate him as a nonessential factor in winning the war. The threat led to the

emergency organization of the National Bureau of Wholesale Lumber Distributors, which successfully defended the wholesalers' right to live and developed into the American Wholesale Lumber Association. This group later merged with the National Wholesale Lumber Dealers Association to form the National-American Wholesale Lumber Association, which now has members in all parts of the country.

The wholesaler had hard sledding also during the days of the NRA Lumber Code, when he almost faded out while waiting for the Washington brass hats to draft an official definition of "lumber wholesaler" so that they could recognize him. As a matter of fact, the writing of such an official definition remains a matter of unfinished business. Everybody in the trade knows what a wholesaler is, but nobody has been successful in reducing this to words.

During the World War II emergency the wholesaler again had a difficult time. The tremendous and urgent demand for lumber in support of the war effort removed practically all elements of merchandising from lumber distribution. The Central Procurement Agency of the Army Corps of Engineers, which provided all the requirements for the lumber-using agencies of the Government, held throughout the producing territory regular meetings with lumbermen at which orders for billions of feet were placed. About 25 percent of the business went to wholesalers, the rest directly to manufacturers. With a ready market thus provided for all they could cut and with the ceiling prices pegged by the Office of Price Administration, many manufacturers who had formerly sold through wholesalers now by-passed their former merchandising facility and began selling direct. The wholesalers complained that the Central Procuring Agency was in reality nothing but a Government-sponsored wholesale lumber distribution agency and duplicated an existing service which they themselves provided, and eventually they were given a measure of relief.

Commission Salesmen

Commission salesmen perform services halfway between the wholesaler and a salaried sales force. Through them the manufacturer may definitely maintain customer contact by direct invoicing, thus keeping the mill's identity before the customer. They sell lumber for the manufacturer on a predetermined sales-cost basis, for which

they are paid a commission, generally five percent, but only on business acceptable to the manufacturer.

The commission man's stock in trade is salesmanship, knowledge of the markets and close contact with a reliable source of supply. As a general rule he lives in the district where he makes his sales, taking occasional trips to the mills to acquaint himself with the facilities of the manufacturers he is dealing with and the stocks available. Commission men generally represent two or more manufacturers of the same or different species, dependent on the sources of supply needed to service properly the trade of their customers. The standard practice is for the commission salesman to keep in close contact with his regular buying trade, offering the stock available from his mill or mills at the prices fixed by the manufacturer, the commission man being recognized in the transaction as the representative of the manufacturer.

The National Association of Commission Lumber Salesmen has done much to promote the use of commission selling by the manufacturers. They have adopted a code of ethics and have worked to raise the standards of this profession. Today the commission salesman is regarded highly for his valuable service to buyers and sellers alike; in fact, there are many mills which depend largely or entirely on such salesman for the merchandising of their output.

Retail Lumbermen

The retail lumber yard is the point of contact between the general public and the industry. The man who means to build a new home or repair an old one or who wants to build a flower box or put up a shelf in the pantry naturally goes to the nearest retail yard for his material. This is also the source of supply of the small—and most of the large—contractors. When the buyer, large or small, walks into the retailer's office, the moment has arrived toward which all the intricate and difficult processes of production are directed. All the dragging of logs out of swamps and mountains, all the work involved in sawing the logs into lumber and transporting it to the market centers, has its culmination in the ultimate sale to the man who is going to use the lumber. The retail yard is the last and vital link in the distribution chain—and there are more than 25,000 of them in the United States.

There are two different kinds of establishments in the retail trade: the single-yard type of operation—which predominates—and the so-called "line" yard type. The single yard is generally managed directly by its owners, and is a thoroughly local enterprise in ownership and in scope. It may be large or it may be small, but its distinguishing characteristic is that it has all its eggs in one basket and looks for its customers in its home town and in the immediately surrounding territory.

The "line yard" is the chain-store style of selling applied to the retailing of lumber—in fact, it was a pioneer in chain-store merchandising. These yards exist principally in the Middle Western states and generally in small towns of agricultural sections. They have individual, local managers, but they are controlled by a central office which not only establishes their policies and prices but also does the buying for them. Centralized buying is obviously beneficial both to the owner of the chain of yards and to the manufacturers who have these large-scale buyers as customers. Line yards have been a factor in the retailing of lumber since the years immediately after the Civil War. Most of them were organized either by large manufacturers or by wholesalers who were seeking to establish dependable outlets. The opening up of the prairie country offered a made-to-order opportunity, as it presented a combination of vigorous demand from new homesteaders and dearth of building materials in thinly populated country with little or no native timber to produce lumber. So the line yards came into being, and, proving profitable, have continued on up to the present time. Some of the chains are small, embracing only two or three yards at near-by points; some are made up of a hundred or more yards, scattered over a fairly large territory.

Nearly all up-to-date retail lumber yards, except the smaller rural ones, are equipped with some form of planing-mill equipment, and perhaps also a resaw, to remanufacture stock to the customer's requirements. Some of these accessory planing-mill plants are equipped to make window sash and doors, although generally such items are made on a large scale in centrally located factories and sold through jobbers.

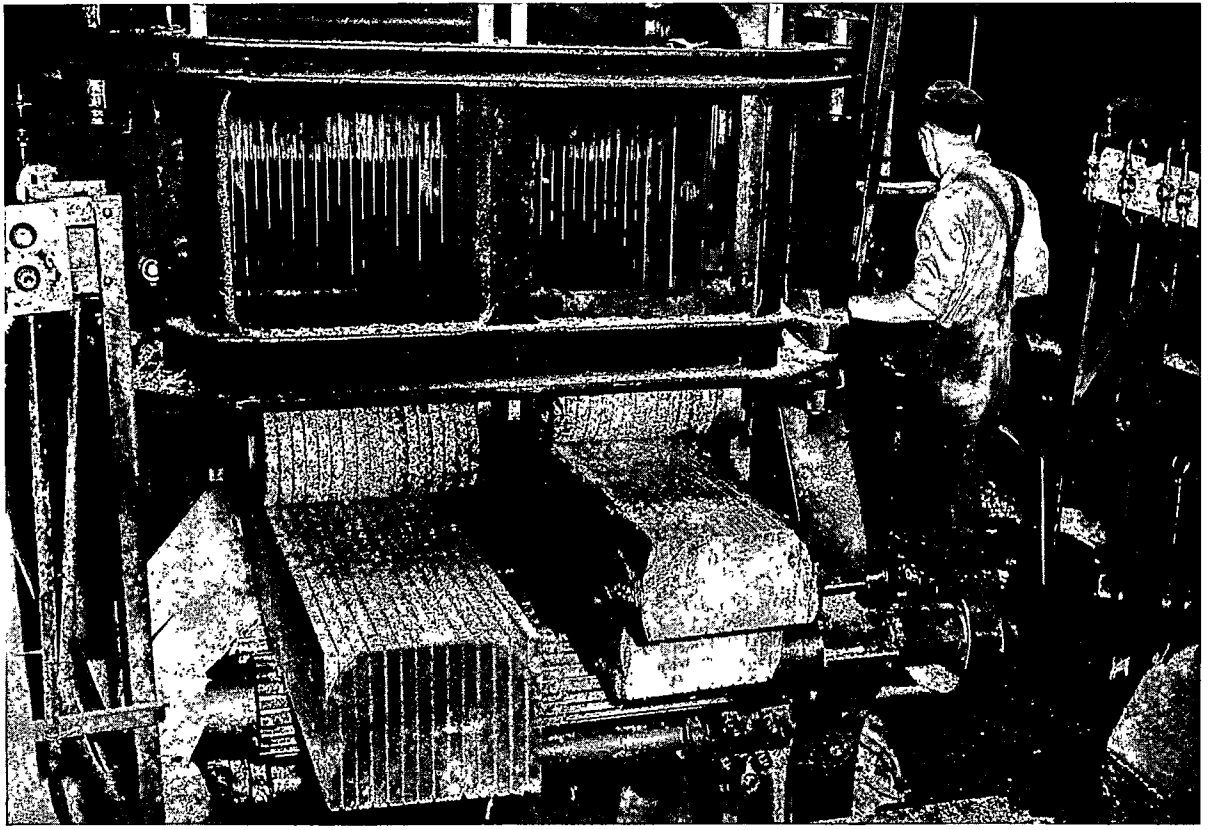
Originally the retail lumber yard was simply that and nothing more—a yard selling lumber at retail to the general public. In the early days it had a shed in which to store its finished lumber which

needed to be protected from the weather, while its stock of rough lumber, fence posts, shingles, etc., was stacked in the open air. If you wanted to buy lumber you went to a retail yard; if you wanted to buy any other kind of building material you went somewhere else.

As the years went by, more and more of the retail lumbermen began to add other building specialties to their stock. They would put in a line of prepared roofing, or paint, or builders' hardware, or fence wire or something else the prospective builder might need in using the lumber he bought. Then came the era of wallboard and plasterboard and other so-called "substitute" materials, and the retail yard seemed to be the natural outlet for them too, as well as plywood. Maybe the home builder would need some brick or cement or sand or gravel for his foundation, so these became part of many retailers' stocks. When insulation became a factor in housebuilding, the retail yards began to stock and sell insulation material. Some of them added other lines, such as coal, to diversify their trade and at the same time to give added service to their customers, particularly in small towns.

Today it is hard to find a retail lumber dealer who deals strictly in lumber. Most of them style themselves "building-material dealers," a designation more accurately descriptive of their business than the old-fashioned term "lumber dealer." Lumber is now a small part of many retail dealers' stock.

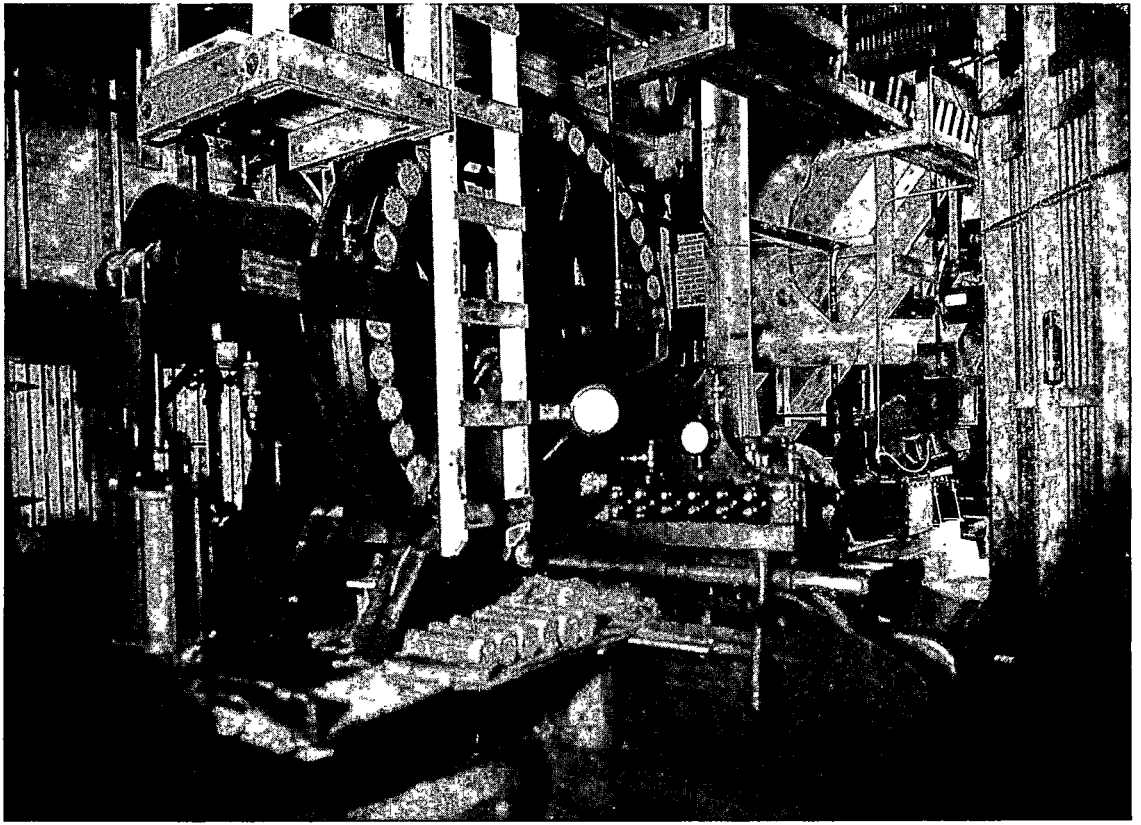
Besides the variety of materials they carry, they have also broadened out in the scope of service they are prepared to render their customers. Many prospective home builders, in fact a large majority of those in the lower-cost brackets, do not employ an architect. So the average retail lumberman now carries as a part of his stock in trade a supply of house plans and even blueprints, covering not only dwellings but, in the rural sections, barns and other farm buildings. To leave nothing to the imagination, he will probably have also a number of small-scale model houses on display, showing just how the completed building will look. As an outgrowth of this sort of service, many retail dealers have gone into contracting and will make a deal with a home builder to sell him all his materials and deliver him the completed house as a lock-and-key job. Some have been so successful at this that they have embarked on the speculative building



K. S. Brown Photo. Courtesy Weyerhaeuser Sales Company

THE CANT GANGSAW

The gangsaw provides quantity production in sawmilling. In one operation it produces a truckload of boards from the cants from the head saw.



MACHINE FOR MAKING FUEL ("PRESTOLOGS") FROM SAWMILL WASTE

of small homes, singly and in subdivisions. It is a little out of their line, perhaps, but it is a way to sell lumber.

During recent years more and more retail lumbermen have seen the wisdom of going a step beyond the merchandising of mere lumber as such. Not all of them can go into the contracting business, but many are displaying on their yards such items as lawn furniture, hog houses, hog troughs, wagon boxes, corncribs, garages and other small buildings which they sell precut and ready for erection or, in the case of the smaller articles, nailed together and ready for use. Some retailers have also made an asset out of waste by fabricating short lengths, broken boards, odds and ends into flower boxes and other useful things. It is small-fry business, but it all helps to make a profit.

The retail dealer is essentially a merchant but, paradoxically, this merchandising branch of the lumber business has been notably weak in merchandising. An outstanding defect in the retailer's methods of selling is that he has habitually offered his lumber on the same basis that he bought it—at so much per thousand feet. This method of pricing has always been confusing to the buying public, as most of the customers cannot visualize a thousand board feet of lumber. Besides, they are not primarily interested in the lumber as raw material; they are interested in the finished product they intend to construct with it. Some dealers have sought to remedy this difficulty by giving up pricing on a thousand-foot basis and adopting the practice of selling at so much per piece. Still others have gone a step farther and have figured out just how much lumber it would take to build a new garage, a new porch or a new roof and have priced the material for the completed job at a fixed lump sum or, better still, at so much per month on the installment plan. They have found that it is easier to sell a customer a garage at $9.50 a month than it is to sell him 2,000 feet of lumber at $95 a thousand feet. But installment selling has been the exception rather than the rule in the retail lumber business.

The retailers' failure to adapt themselves to modern merchandising methods was conspicuously revealed in an analysis of retail selling made by the United States Department of Commerce in 1937. This survey showed that the retail lumberman's principal competitors for a share of the consumer's dollar—the sellers of automobiles, furniture and household appliances—were all making most of their sales on the installment plan, with a relatively small proportion on open

account. The lumber dealers' sales, on the other hand, were 89.6 percent on open credit, 9.6 percent cash and only .8 percent on installment contracts.

During recent years, however, more and more of the progressive dealers are beginning to realize what they have missed by not considering the public's demonstrated preference for installment buying. To assist retailers in developing this business a plan has been established similar to those which have made the financing of automobile sales convenient and easy. The system, known as Allied Building Credits, is a Weyerhaeuser institution and furnishes the machinery through which lumber dealers can sell on the installment basis and get their money immediately.

Installment selling has many advantages which dealers are rapidly recognizing. It creates new business because it fits in with the buying habits of the people; it improves the dealer's cash position; it lifts the sale out of the "raw material" class; it enables the dealer to render a service to his community; and it builds an economically sound and satisfactory credit basis for both customer and dealer.

A few years ago there was considerable agitation in retail lumber ranks over the specter of competition from the mail-order houses. These great merchandising organizations, reaching out for more worlds to conquer, began to list lumber in their catalogues, going from that into the offer of ready-cut house bills and then into prefabricated houses. All of this kind of merchandising, by-passing the established retail lumber yard, was looked upon by the retailers as unwarranted invasion of their legitimate field of endeavor, and they fought it in every way they could. The mail-order houses, however, continue to sell lumber by mail; and although the total amount they sell is not large it is enough to prove a constant source of irritation to the retail yards in the rural sections, especially in the Middle West. Many dealers have successfully combated this competition by educating their customers into the advantages of buying at home: quick delivery, seeing what you are buying, credit if desired, etc. In general, it may be said that the active, efficient, resourceful retail lumber dealer's business has not been greatly injured by this mail-order competition.

Mail-order competition is not the menace it once was, but many dealers feel increasing apprehension over the possible effect on their business of prefabrication. Where will the dealer of the future

find his customers if the home builder can buy his house in knocked-down, prefabricated form, delivered on his lot, ready to assemble?

"Prefabrication" for a time was a word of almost mystic significance in the building world, and there is a suspicion that a lot of people have used it without knowing exactly what it means or even what they think it means. Maybe it means a factory-built house, which will be shipped knocked-down to the building site and there erected without further carpenter work than nailing it together. But such houses have been sold—principally for camps and summer cottages—for years; they are not new. If prefabrication means the dwelling of the future will be so standardized that it will lend itself to mass production and low manufacturing costs, it may be questioned whether such a house—granting the feasibility of its construction—would be popular except with a very limited few. The average home builder wants an individualized house, built to suit his own particular needs and ideas, and the production-line, standardized variety does not meet his requirements.

There has, of course, always been a certain amount of prefabrication in all construction. When the first settlers stopped building log houses and started sawing the logs up into boards and framing, they were taking the first step in prefabrication. All parts of the house were then manufactured on the job by the contracting carpenters. Out of the rough lumber they built the frame and exterior of the house; they made the doors and windows and floors and everything else. Then, gradually, it became the custom to manufacture parts of the house in woodworking shops or factories and bring them ready-made to the site—doors, windows, mantels, moldings, flooring, medicine cabinets, closets, kitchen cabinets, etc. Today a large part of every house is prefabricated in the sense that it is delivered ready-built on the job. To some extent, therefore, it seems that the bugaboo of prefabrication—from the retail lumberman's standpoint—has been somewhat exaggerated.

In a recent series of articles the *Architectural Forum*, describing wood as the "material of realization," stated that prefabrication "has now finally arrived through the use of wood. . . . It is no longer a matter of theory or experimentation; it is a practical production technique in use on a substantial scale. In the past two years some 60,000 factory-made wooden houses have been manufactured, shipped to the site and erected. Almost as many have been site-fabricated in

panel form, using jigs, templates and other labor-saving devices with much of the speed and efficiency hitherto identified only with factory production. In addition to war housing, scores of other types of light structures are being prefabricated for use on farms and by the armed services. All told, a sizable proportion—if not a major part—of the total light and medium construction since the defense program got under way has involved prefabrication in one of its numerous forms, and in most instances the basic material used has been wood."

This authoritative recognition of the adaptability of wood to prefabrication comes as no surprise to the lumbermen. They know, from years of experience, of lumber's flexibility in utilization, and a good many retail dealers are inclined to view the subject with composure. They have grave doubts as to the large economies mentioned vaguely in connection with house prefabrication, and express the view that they are largely paper economies. One Ohio dealer sums it up in these words:

A house is composed of (1) foundation, (2) frame, (3) wall construction, roof, and room partitions, (4) finish, and (5) utilities.

You can't prefabricate the basement, although we do have sectional forms easily installed into which to pour the concrete once the excavation is ready.

We use precision-cut dimension for the frame. We do a lot of the other cutting in our mill, and our contractors have portable power saws on the job.

We use factory-finished flooring, factory-built door units, factory-built kitchen and bathroom-cabinet sections, factory-built fireplace mantels. All these are already prefabricated.

That leaves the wall sections and the utilities. We've tried to prefab wall sections and results were not satisfactory.

The furnace, the water, gas and electric line will have to be hooked up and installed at the site.

So the modern house, built by conventional methods, is pretty much a prefabricated structure. It will become more so naturally, without losing its individuality thereby. But when you attempt to assemble these prefabricated parts on an assembly line, one of two things escapes—individuality or economy.

Retailers were hard hit by the upheaval in supply and distribution brought on by World War II. Even before Pearl Harbor, when it was a "defense" program rather than a "war" program, lumber was recognized as an essential material in the national effort, and retail

yards had to take what was left after the Army and Navy and other governmental agencies got what they wanted from the sawmills' output.

The Government's need for lumber to carry on its building program became so acute, during the early months of 1942 that on May 13 the War Production Board clamped down the first of its restrictive orders, No. L-121. This "froze" all softwood construction lumber, and threw the retailers into a flurry of excitement as they saw their stocks gradually melting away with no opportunity of replacing them. Three months later they were given some relief when M-208 succeeded L-121, the new order permitting buying for replacement. This boon was shut off within a few weeks, however, when M-208 was amended to stop replacement buying, and after that the retail yards experienced great difficulty in maintaining even a limited supply of lumber.

To make doubly sure, there were governmental prohibitions and limitations set on construction, which dried up most of the retailers' normal demand. It was permissible for them to supply lumber for war housing and other essential forms of building, and for maintenance and repairs "essential to the health and safety of the civilian population," but this left mighty slim picking for the average retail-yard man, especially in localities removed from the war effort.

These restrictions constituted a challenge to the resourcefulness of the retail lumbermen; and, on the whole, they reacted to the challenge in a way that did them credit. Some dealers, to be sure, ran up the white flag and retired from business—at least "for the duration." But most of them kept on fighting. They concentrated their activities on nonessential and unrestricted materials and on supplying those jobs which were permitted under existing regulations. They went to the sawmill territory and ransacked the mills' yards and sheds for noncritical items, even in small lots, and then they devised ways and means of using such material to serve their customers. The spur of wartime necessity drove retail dealers to new extremes of resourcefulness.

A number of retail yards with planing-mill equipment shifted over into direct action in the war effort by making ammunition boxes and other wood items needed by the Army and Navy. The involvements connected with Government contracts proved formidable obstacles in some instances, but retailers showed a ready adaptability in

meeting the changed conditions. An Ohio dealer, commenting facetiously on his red-tape troubles, said that he had worked out a reliable formula for determining when a Government contract was completed. "I weigh every shipment we make on a giant scale," he said. "Then I weigh all the incoming forms, questionnaires, certifications, mimeographed letters and changes in specifications. When the weight of the incoming papers balances the weight of the outgoing shipments, I figure that then the contract is completed."

One dealer's stocks got down so low that he was practically cleaned out of every kind of lumber. When a customer came in and said he had to have a board eight feet long and twelve inches wide the dealer pointed to his supply shed and said, in desperation, "The only twelve-inch board I've got on the place is that sign over the driveway." The customer looked at the sign and sized it up. "That will suit me exactly. How much do you want for it?" So the dealer sold his sign, and the customer went away satisfied.

Since the close of World War II the 25,000 retail lumber dealers of the country have played an important part in supplying the materials for the great surge in home-building which has brought the nation's volume of construction to record-breaking levels year after year. Millions of new homes have been built during this post-war era of construction activity, and billions of feet of lumber have been channeled through the retail yards into the building of these homes.

The national emergency created by the outbreak of hostilities in Korea has brought about restrictions in credit and also some restrictions in the use of some scarce materials essential to the defense effort; but the retail lumber dealers are meeting this emergency with their characteristic resourcefulness and ability to adapt themselves to difficult circumstances.

Chapter X

ECONOMICS OF THE LUMBER INDUSTRY

ECONOMIC problems associated with the lumber business are rendered more complex by their constantly changing nature and the shifting of conditions within the industry which affect the production and distribution of lumber.

There was a time when the lumberman's problems were so simple as to be practically nonexistent. The country was growing up, growing at an extraordinarily rapid rate, and there was a strong and insistent demand for lumber of all kinds. The population of the country was expanding every year; so was the consumption of lumber. Before 1910 there was a potential demand of four and a half billion feet annually from new farms alone. Timber was plentiful and cheap and accessible to the markets. It was not much of a feat to make money in those days. You bought a tract of timber and sawed it into lumber and sold the lumber and wound up with a lot of money in the bank. Sometimes what looked like genius was nothing more than the irresistible working of natural forces. Many an early lumberman acquired a reputation for great business sagacity as an operator, when most of his success was just due to the automatic enhancement in the value of the timber he was liquidating. Of course it required some foresight and judgment to recognize timber as a good investment; but it was possible to buy it almost with your eyes shut, secure in the knowledge that it would enhance in value from year to year.

But as the years went by a change ensued. The price of standing timber went up; carrying charges went up; taxes went up. And one important thing was going down—the per-capita consumption of lumber. The saturation point was being approached; people did not need so much lumber. As a mere speculation timber began to lose some of its attractive features. As a raw material for a lumber enterprise, which had to make its profit in the manufacture and sale of the product, it had to be bought with more circumspection.

As these conditions grew in intensity, the stands of accessible old-growth timber were becoming scarcer. The manufacturers had to invest in timber in far-off places, where it was hard to get the logs out

of the woods and where the lumber, when manufactured, had to be hauled a long way to market. It was no longer possible to make money automatically. A successful lumberman had to be something more than a timber speculator and liquidator. He had to be a competent and skilled production man—and, in addition to that, he had to be a merchandiser. Lumber no longer sold itself. When it went into the market place it found plenty of competition.

Competition in the lumber business is of a dual nature. Southern pine timbers and Douglas fir timbers compete with each other in the construction field, but they must both compete with steel beams and girders. Oak may compete with walnut in the office-furniture market, but they both compete with steel and aluminum. In past years the lumbermen's attention has been so concentrated on the intra-industry competition between the species that they have frequently overlooked the competition of some other material until it has taken the market away. There have been countless repetitions of this, and the result is that during the past fifty years the per-capita consumption of lumber in the United States has shown a steadily downward trend.

In 1904 the average consumption of every man, woman and child in this country was 504 feet. In 1939 it was only 194 feet, and it had reached an all-time low of 94 feet in the depression year of 1932. In 1942, during the war, it bounced up to 315 feet per capita; in 1949 it was down to 220 feet. So long as the population was greater every year, this decline was not such a serious matter; the total consumption held up fairly well. But it now appears that in the future the population increase may not be so great, and if the total volume of lumber business is to be maintained or augmented it will be necessary to sustain and build up the per-capita consumption.

Transportation

Transportation has always been a potent—perhaps the most potent—factor in the evolution of the lumber industry. The greater part of the processes involved in production are essentially phases of transportation: the decking of logs in the woods, the hauling of the logs to the mill, the shipping of the lumber to the customer. This dominating part is evidenced by the fact that in 1949 when the average mill price of lumber was $67.41 per thousand feet, the rail-freight cost

of delivery of that much lumber was $18.51. Southern pine remained undeveloped until the railroads were built and it could be sold in the Northern markets. The Western lumber industry owed its beginning to the building of the transcontinental railroads and the favorable rates they accorded lumber to Chicago and Minneapolis; its later stimulation was due to the economical access to the Atlantic Coast made possible by the opening of the Panama Canal.

In recent years the advent of the motor truck, with the accompanying spread of well-paved highways, has introduced a new element into the production and distribution of lumber. Trucks have lowered operating costs for mills logging their own timber. They have widened the scope of the supplying territory from which mills can buy and get logs. They have made possible the modern concentration-yard system of merchandising small mills' output. They are used to a steadily increasing degree in the delivery of lumber from the sawmill to the retail yard or ultimate customer.

The marketing territory open to the various species and grades of lumber is largely controlled by the freight rates charged by the railroads. The question of the rates and rate differentials affecting the two major producing regions, the West and the South, is particularly intricate. It is sometimes baffling in its complexities to even the lumbermen and transportation experts, and is almost incomprehensible to the layman. Sufficient to say that during the past few decades the Southern pine mills have had their markets gradually circumscribed by the changing relationships, as the Western mills extended their markets by the same token. The Western mills, to be sure, pay a higher basic freight rate per hundred pounds; but, owing to their lower costs of production, they are able to sell profitably in the markets of the Central and Eastern States in competition with the Southern mills, even though Southern pine enjoys the advantage of the shorter haul and lower freight rate.

Labor

The competitive relation between these two regions is somewhat the same in labor conditions as in transportation. In the West the wage rate per hour is higher than it is in the South, and always has been. Generally speaking, the basic wage for common labor on the West Coast is about twice what it is in the South; but in the long

run the Western operator really gets more for his money. Involved are not only the relative efficiency of the labor employed, but also the larger size of the timber in the West and the greater mechanization of the industry possible there. The effective combination of these factors is reflected in the statistics gathered by the United States Department of Labor showing the man-hours required for the production and distribution of a thousand board feet of lumber in the principal producing sections. For all operations involved—logging, manufacturing, selling, administration and transportation—they are 41.7 for Southern hardwoods, 38 for Southern pine and 26.6 for Douglas fir. Eliminating the selling and distribution figures, the relative man-hour requirements in actual production show an even greater disparity: logging—15 for Southern hardwoods, 10.9 for Southern pine and 5.4 for Douglas fir; manufacturing—20.6 for Southern hardwoods, 17.8 for Southern pine and 10.5 for Douglas fir.

Taxation

Next after transportation and labor, the most important economic influence is taxation. Much of the so-called devastation of timber in the past was due to the shortsighted, greedy, oppressive measures of local taxing authorities which made it economically imperative for the timber owner to cut out and get out or be ruined. Gradually the fact came to be recognized that taxation is closely tied in with forestry and conservation. In various states efforts have been made to modify the method of taxation so as to encourage the treatment of timber as a growing crop. Just as the owner came to realize the wisdom of maintaining his timber as a continuing source of saw logs, so some local authorities have grasped the desirability of keeping timber and its dependent industries continuing sources of tax revenue.

Timber taxation is a subject that has engaged the study of fiscal and forestry experts for years, but there is still no general agreement as to just exactly how it should be worked out. Various approaches have been made from various angles: modification of the standard *ad valorem* property tax; separate valuation, for taxing purposes, of land and the timber growing on it; some form of yield tax which relieves the owner from the heavy burden of annual taxes while his timber is growing, but requires the payment of the yield tax in a lump

sum when it is harvested. The last plan seems the one most favored by modern students; in different forms it is now in effect in a number of the states of the union.

An ideal timber tax law is one that gives the owner sufficient relief to encourage him to practice forestry and, at the same time, does not cripple the community by shutting off its revenues. So far, such an ideal law has not been evolved, and forestry is pursued today in the face of inequitable taxes.

As long ago as 1819 the relationship between taxation and forest conservation was officially recognized by Governor Walcott of Connecticut, who said in a message to his state legislature: "Timber and woodland may also be considered as capital, of which the interest and profits are deferred for periods of from twenty to one hundred years. If taxed annually, the rates ought to have reference to the remote periods at which the income will be received, it being certain that an excess taxation would accelerate the destruction of timber and wood and occasion ruinous mischief."

The "ruinous mischief" foreseen by Governor Walcott has come about, not merely in Connecticut but in other states where the preservation of forests is of even greater financial importance, but no solution of the problem has yet been found. The United States Forest Service conducted an exhaustive study of the subject a few years ago, and said bluntly: "While the forest-tax legislation of the past has given valuable experience, it has been chiefly negative in character. As yet no law has been developed which may be regarded as representing an adequate and positive solution to the forest-tax problem."

This study by the Forest Service was inconclusive, in that it made no recommendation of specific legislation. It stated frankly in its report: "It is useless to seek an easy and simple solution of the forest-tax problem. This problem is closely related to the shortcomings of the prevailing system of local government and cannot be solved by any one-sided attack." It concluded that, since the problem concerns all owners of real estate, it should be approached in a broad way, with the interests of all taxpayers in view, further suggesting that a broad attack upon the problem would consist of three different parts:

(1) Reduction in the total cost of local government, particularly in the forest regions; (2) improvement in the operation of the property tax, and (3) modification of the property tax as applied to the

forests, by permitting adjustment of the tax burden to deferment of income.

The Forest Service report also says:

> The removal of the tax obstacle cannot by itself be expected to bring about the general application of forestry principles to privately owned forests. Nevertheless, the removal of this obstacle would be well worth while. Forest-tax reform would give the forestry use an equal opportunity, so far as the tax burden is concerned, with competing land uses, and would offer investments in forestry a degree of security against the hazards of the property tax as now administered. The accomplishment of these results would constitute an important part of a well-rounded program designed to promote the productive use of private forest lands.

A point not brought out by the Forest Service study, but one now receiving much attention, is the effect of Federal taxation on the forest industries, particularly with reference to the practice of forestry. The existing system of Federal taxation, as applied to forest crops, is recognized as being complex, inequitable and not conducive to long-time capital investments by forest owners. What is sorely needed is a complete overhauling of the Federal tax laws as they apply to timber and the forest-products industries. Such a revision of the tax laws would be one of the greatest contributions to the cause of forestry that could be made.

Trade Promotion

From time to time attempts have been made to stage organized trade-promotion campaigns on the part of the whole lumber industry in order to convince the public of the wisdom of using lumber rather than substitutes offered in its place. Most of these campaigns languished because it was difficult to promote lumber as such; the ultimate consumer, sold on the idea of using it, always wanted to know what kind of lumber to use—and no trade-promotion campaign financed by the manufacturers of all the species could very well recommend one over another. Consequently trade promotion is now conducted principally by the various regional and species groups, each seeking to expound its particular merits. Some broad-visioned lumbermen have questioned the wisdom of this on the ground that it

puts the industry in the position of competing within itself, but, due to the nature of the business, that seems hard to avoid.

It is conspicuously demonstrated in the case of the softwoods. Douglas fir and Western pine are directly competitive with Southern pine; redwood and cedar are competitive with cypress—and with each other. The manufacturers of these several species have co-operated in broad, general efforts to promote the interests of the industry. In such activities as the development of the Teco connector system of construction, or movements looking to the improvement of public relations, it has been feasible for them to work together effectively. Southern pine, however, must be sold in direct competition with Douglas fir and Western pine, and that competition is intense.

Exports and Imports

The volume of lumber exports and imports is not large compared with the total production in this country. There was a time, however, twenty years ago, when exports totaled three billion feet a year. On the Pacific Coast and in the South the export trade was a vital feature in the business of those mills so situated as to cater to the foreign demand; it took about 25 percent of their volume and served as an outlet for much lumber not readily or profitably salable at home. There was a gradual shrinkage in exports, however, and by 1940 the total shipments abroad amounted to less than a billion feet.

The export trade was greatly diminished and disorganized by World War II. About all the lumber shipped from this country was that sent to the Allied nations for war needs, generally under the terms of the Lend-Lease law. Since the war, exports have languished, and the total volume of export shipments in 1949 was 667,201,000 feet, less than two percent of the production.

The present shrunken condition of the export trade is not entirely the war's fault. Shipping difficulties, foreign discriminations and preferences, and other economic factors began to undermine our lumber exports more than twenty years ago. Our volume of shipments reached a peak in 1928, but started downward in the early thirties, and reached a forty-year nadir in 1938, when the total dipped below the billion-feet mark for the first time this century. Exports picked up slightly in the first part of 1939, but dropped again after September when war broke out in Europe. The summer of 1940

showed some revival, but it did not last long and that year hit a new low—but '41 went lower still, when exports did not exceed two percent of the total production, whereas in 1900 the ratio had been eight percent. In the ten years just preceding the war the United States dropped from first place to fifth in world lumber trade.

Taking 1937 as a typical prewar year, an analysis of the export statistics on species and destinations is interesting and informative. Total exports were close to a billion and a half feet, about two-thirds softwoods and one-third hardwoods. A little more than half the softwood was Douglas fir, 35 percent of it Southern pine, the rest divided among the other coniferous species. Oak constituted about half the hardwood total, ash about 12 percent, with the remainder scattered over poplar, gum, etc.

Japan took about 30 percent of the Douglas fir shipments that year, with China, Australia and Argentina its other leading importers. Japan had long been a heavy buyer of our fir lumber, timbers and logs. Its purchases reached half a billion feet in 1928; but after 1937 its importation fell off sharply and was only about 10 percent of the total during the next three years. In 1937—as in all other years—the United Kingdom was the principal buyer of American hardwoods, taking 70 percent of the amount exported. Britain's adoption of the "Trade with the Realm" policy sharply reduced her purchases from us, bringing them to the lowest point in lumber history in 1940, and this explains why the total exports of American hardwoods in 1940 were so low.

In normal years before the war the United Kingdom was the world's largest importer of lumber. Its imports amounted to more than six billion feet annually, of which about 90 percent was softwoods. Around 75 percent of the softwoods came from Russia and the Scandinavian countries, about 23 percent from Canada, and the remaining 2 percent from the United States. Of her hardwood imports, 32 percent came from the United States, 20 percent from Canada, 14 percent from other Empire origins, and the remainder from the Continent—along with some oak from Japan.

During World War II Sweden, Finland and Russia were cut off from Great Britain and she was deprived of these customary sources of softwoods. To meet the emergency, she resorted to a most rigid economy in the use of lumber ("timber" they call it over there). To maintain an inventory for essential uses she increased her importa-

tions from Canada, and also bought some necessary hardwoods, along with lesser amounts of softwoods, in the United States. As far as possible, however, she met her wartime lumber needs from her home-grown timber resources, and this produced a surprising volume of material—1,350 million feet during 1941.

Since the war, due to dollar scarcity and internal political policies, Great Britain's purchases of our lumber have fallen away almost to the vanishing point: 67,836,000 feet of softwoods in 1949 (as compared with 250,311,000 feet in 1930), and 13,247,000 feet of hardwoods in 1949 (as compared with 236,986,000 feet in 1930). Our exports to other parts of the world have also been smaller, the shipments of hardwood lumber to Canada being about the only segment of the export trade in which the shipments of recent years have been of comparable volume to the years before the war.

The importations of foreign lumber into the United States had been declining very considerably for a quarter-century or so before the war. Twenty-five years ago the total was in the neighborhood of two billion feet per annum, but during 1937 amounted to only 686 million feet. Of this, 572 million feet was softwoods—515 million came from Canada and 36 million from Russia. In the hardwood imports maple, beech and birch from Canada provided about half, and Philippine hardwoods—including "Philippine mahogany"—about a third. Further hardwood imports were oak from Japan, and mahogany and other cabinet woods from Cuba, Africa, Central America, Brazil and Peru. Since the war our lumber imports have steadily mounted, reaching 1,574,204,000 feet in 1949 and having been in excess of a billion feet annually for the preceding four years.

Although constituting only a relatively small portion of the total lumber imports, the tropical cabinet woods impart one of its most interesting and romantic features to the American lumber business. This is particularly true of mahogany. Our mahogany industry is a sort of paradox: it deals entirely in a foreign wood, but it is entirely a domestic enterprise. Most of what we use is imported in the shape of logs, either round or roughly squared, and is manufactured into lumber or veneers on our mills. Botanically the true mahogany is of the *Swietenia* and *Khaya* genera, growing in the West Indies, Central and South America and Africa. It is a peculiarity of the tree that it does not grow in stands like other species, but is found singly or in

isolated groups. Mahogany is justly known as king of the cabinet woods. Its name is associated with our traditions of fine furniture. During the war, however, it was used extensively for building boats, airplanes and gliders. Chippendale and Hepplewhite never dreamed of PT boats and bombers that could fly at 400 miles per hour, but they would be proud of the craftsmanship displayed in using their beloved mahogany to make the wartime torpedo boats and aircraft.

About 12 percent of the hardwood importations into the United States consist of the Philippine species technically classified as lauan, tanguile, bagtikan, tiaong, mayapis and almon. This lumber, although botanically different from the *Swietenia* or *Khaya*, is sold here under the trade name of "Philippine mahogany." The use of the term has been contested by the manufacturers of the true mahogany genera. There have been conflicting and contradictory rulings, but by the most recent decision the woods may be sold as "Philippine mahogany."

Particularly interesting among the imported tropical woods is lignum vitae. It is an exceedingly hard, resinous wood, the hardest, heaviest and closest-grained wood of commerce, with a density almost equal to iron. It weighs about 83 pounds per cubic foot, and has a specific gravity of 1.3. Its great density and homogeneity make it capable of withstanding a working pressure of 2,000 pounds per square inch. The high resin content, which runs about 30 percent of the weight, consists of a natural gum which, combined with its pressure-resisting quality, renders lignum vitae admirably suited for an ever-increasing number of mechanical purposes where the introduction of lubrication is not practicable. It is this self-lubricating quality that makes it valuable to shipbuilders for bearings or propeller shafts and rudders. It has found a wide application in other uses of war and peace.

At the other end of the weight scale is balsa, the featherweight wood, another curious species from the tropics. Balsa is the lightest commercial wood known—only half the weight of cork—and the strongest wood in relation to its weight. A man can carry a log of balsa on his shoulder with ease. Among other wartime uses it went into the manufacture of the famous Mosquito bombers and other aircraft, and into making life rafts, life preservers and other products requiring buoyancy. Balsa is imported mainly from Ecuador, but it grows also in Central America.

Despite the relatively small volume of our lumber imports, the American industry's interest in the tariff has always been more or less active. Since most of our imports have come from Canada, this interest has been sharpest among the manufacturers who are located closest to the border and whose products come directly into competition with Canadian lumber and shingles. Their advocacy of a high tariff has been complicated and diluted by the fact that some of the Canadian mills were owned by American capital, and some American mills derived part of their log supply from Canada. In general, the lumber manufacturers of the South have favored a protective tariff on lumber as a matter of principle, although the actual direct impact of the imported lumber on their business has been so slight as to make their interest more academic than real. As a matter of fact, the statistical record does not reveal any very marked change in lumber imports from Canada as paralleling change in the tariff rate from time to time.

Lumber Grading and Inspection

All trees are not alike, and when they are cut down and sawed into lumber all the boards they produce are different. Some boards have knots or other defects—a few, or very many. The earliest commercial manufacturers and sellers of lumber realized that there ought to be a system of classification by grades, so that boards of relatively the same quality and utility value might be grouped together, and so that different prices might be charged for boards of different value. All early grades were on an individual or local basis, and many years passed before an approach was made to the present system of grading and inspection designed to insure that the lumber buyer uniformly gets what he buys.

The first printed grading rules for lumber of record were published in Stockholm in 1754. They classified and defined four simple grades of Scandinavian pine: Best, Good, Common and Culls. In America the matter was for a time left largely to the whim of the various local markets, and there was nothing resembling uniformity of grades for any species. Most of the mills sold their output "mill run," without regard to grade, and the wholesalers who bought it graded it and sold it according to the local rules. Efforts made from time to time to standardize lumber grades in cities or states by legislative enactment

were mostly fruitless. Not until the latter part of the last century was something approaching standardization of grades for the various species first attempted, and it was done through the medium of the lumbermen's associations as they evolved to the point of being able to establish the rules and apply them.

Whatever else may be said of them, those early lumber grading rules were succinctly expressed and easily understood. The rules adopted by the Yellow Pine Lumber Association in 1884 for the grading and classification of yellow pine lumber, for instance, consisted of the following brief specifications:

DRESSED AND MATCHED FLOORING: *First and Second*—Shall be clear of knots on the dressed side, but may contain all bright and well-worked sap; two or three small pin knots not over half of one inch in diameter on the heart face will be allowed. *Common*—Shall not contain any First and Second clear, but may contain all sound knots, some splits, but no blue or loose knots. *Standard*—Shall be 50 percent clear and 50 percent common.

STEP STUFF: Shall be free from knots on best side; may have two inches bright sap on edge and kiln splits not over 12 inches long at end.

BOARDS: *Standard*—Shall be run of logs, but no loose knots or blue sap. *First and Second Rough*—Shall contain no knots on best side, and may contain all bright sap. No shakes will be allowed. Kiln splits not over 12 inches will be allowed.

The hardwood grading rules of the eighties were also simply worded and free of complications. In 1886 the New York Lumber Auction Company published its private rules for hardwood inspection, with varying specifications for the only nine varieties handled: walnut, ash, cherry, oak, whitewood (poplar), basswood, maple, chestnut and butternut. The oak rules, to give a sample, were:

The standard lengths are 12, 14 and 16 feet.

The standard thicknesses are 1, 1¼, 1½, 2, 2½, 3, 4, 5 and 6 inches, and are inspected as firsts, seconds and culls.

Firsts—Must be 8 inches and over in width, clear and free of all defects. Small defects allowed in accordance with the width of board, but boards having wormholes absolutely excluded.

Seconds—At 8 inches in width one or two small knots or a little sap may be allowed, and at 10 inches and up other small defects may be allowed, according to width of board.

Culls—Any board that is wormy, knotty and unsound generally.

In the softwoods the present grading rules are made by organizations of manufacturers of the species involved. The standard grades for hardwood lumber are those of the National Hardwood Lumber Association, which is composed of manufacturers, wholesalers and industrial consumers. All the rules are capable of being changed from time to time to adapt them to changing conditions, and the machinery for their application includes methods of certifying the shippers' inspection for protection of the buyer.

Considering the manner in which they developed, it is not surprising that the standard rules for grading the different species of lumber bore little or no relation to one another. Different terms were used to describe the different grades as established within a species group; but when the same terms were used in describing grades of other species they might or might not refer to a comparable grade. A "Number One" board in white pine might be an entirely different class of board from a "Number One" Douglas fir or Southern pine board, and so on.

Also there was the matter of sizes. The specified sizes of softwood lumber are only nominal, and refer to the sizes of the rough, green material. An "inch" board is not an inch thick after it has been dressed; its thickness depends on how much was removed by the planing mill in dressing—and planing practices differed in the different species. No dressed two-by-four is two inches thick and four inches wide; in the old days two-by-fours of one species might be larger or smaller than two-by-fours of another.

As the years went by the confusion increased. Gradually the idea began to grow that there ought to be some sort of standardization and simplification of softwood-lumber grades and sizes. This movement was started in 1919 when the lumber industry, acting through the American Lumber Congress, expressed a desire for it. But nothing much was done until 1922 when Herbert Hoover, then Secretary of Commerce, offered the services of his Department.

A long series of conferences ensued between representatives of the various softwood groups, leading to what was known facetiously as the "Battle of the Thirty-Second." This "battle" grew out of the effort to reconcile the varying views of just how thick a dressed board ought to be—there seemed to be almost as many opinions as there were groups. The Forest Products Laboratory was called into consultation and, after studying the problem, handed down the opinion

that "theoretically" the most desirable thickness was $^{26}/_{32}$ of an inch. The officiating committee of lumbermen had recommended $^{25}/_{32}$ of an inch, but some groups insisted that it should be $^{1}/_{32}$ of an inch thicker. The contest raged so long that it was finally referred to Secretary Hoover himself. He handed down a judgment of Solomon which is the rule today: $^{25}/_{32}$ of an inch is the standard size for a dressed inch board; but $^{26}/_{32}$ of an inch is recognized as an "extra-standard" size—later officially designated as "standard industrial lumber." None of this applies to hardwood lumber which is generally sold rough, with the specified sizes the actual sizes.

At length in 1924 the first edition of the "American Lumber Standards" was approved and printed. It defined the basic grades of softwood lumber, establishing a sound foundation for continued efforts to equalize grades, and also set up a system of standard sizes which reduced the number of actual finished yard-lumber items by nearly 60 percent. Later basic rules and standard sizes of softwood factory and shop lumber were added, also basic provisions for the selection and inspection of softwood timbers and dimensions for uses where working stresses are required. Included also in the standards was a list of commercial names for lumber cut from the principal softwoods, definitions of terms used in describing standard grades of lumber, outlines of a new series of standard moldings, and standard lumber abbreviations.

One of the clauses of the American Lumber Standards, after saying that "the principle and practice of grade-marking lumber are approved," goes on to outline the procedure for grade-marking each piece of lumber "to signify that the lumber conforms to the grade specification of the rules under which it is graded." The grade-marking proviso is not mandatory, but many manufacturers have adopted it and grade-marked lumber may be had when desired. To guarantee the grade of lumber which is not grade-marked, certificates of inspection are available from the regional organizations applying the grading rules. Grade-marking has not been considered feasible in the hardwood trade, but certifications of inspection may be had from the National Hardwood Lumber Association which guarantee the grade of lumber so shipped.

The American Lumber Standards now provide the basis on which all the softwood grading rules are founded, and their maintenance is assured through a Central Committee on Lumber Standards, charged

with the duty of seeing that regional and species grading rules conform to the standards.

It has been the experience of the lumber industry that the administration, supervision and conduct of inspection services may best be accomplished through the medium of the various regional and species associations. These associations are generally so constituted that they cannot be dominated by any individual company; they have been organized and maintained to serve the interests of the whole industry. Inspection services were conducted in this manner for many years. In 1940 the Department of Justice, contending that nonmembers did not have equal opportunity in competition with members, forced the separation of the inspection services of one association from connection with its general activities. In other associations the Department required changes in the procedure which, in its opinion, assured equality of treatment to members and nonmembers in inspection matters.

The effect of these changes has not been particularly noticeable. In general, all qualified inspection agencies, whether established directly under association auspices or otherwise, have equal standing and recognition. Lumber-grading requires considerable exercise of personal judgment, and there can be no dependable assurance of impartial application of grading rules unless the inspection agency is free from the controlling influence of any single company or group. Speaking broadly, the inspection services under the auspices of the associations have had the most extensive facilities and the most experienced personnel, and lumber buyers have usually preferred them.

Chapter XI

LUMBER IN WARFARE

FROM the beginning of history wood has figured prominently in the waging of wars. The first battles were fought between shaggy men armed with wooden clubs and carrying wooden shields. Primitive people of a later age used spears and bows and arrows made of wood, and moved to war in dugout canoes made from tree trunks. Wooden catapults hurled large stones against beleaguered enemies, and wooden battering rams broke down their walls. The Trojan horse was made of wood. Julius Caesar's campaign against the Germanic tribes depended on his ability to span the Rhine with a wooden bridge. Early settlers protected themselves behind wooden palisades. As civilization advanced and there was a corresponding advance in the fine art of warfare, a greater use of steel and other metals ensued. Wood, however, continued to be recognized as an essential material in every war that mankind has ever waged.

The outcome of every war depends at last on the final decisive clash of the infantrymen, the men with guns in their hands, and no satisfactory substitute has ever been found for walnut for the stock of the Army rifle. In every war to World War II, the artillery has been mounted on wooden carriages and guns have been served from wooden caissons. For centuries wagons built of wood have hauled the supplies of moving armies. Andrew Jackson's Tennessee riflemen floated down to New Orleans in flatboats made of wood. Wooden warships were the mainstay of the world's navies until the *Virginia* and the *Monitor* introduced the new age of armor-clad ships—and even dreadnoughts can't be built without large quantities of lumber.

During World War I the United States used something over six billion feet of lumber, largely for the construction of Army cantonments. At the time that was considered a tremendous lot of lumber, but it was hardly a drop in the bucket compared with the many billions demanded in World War II for a bewildering array of Army and Navy essentials.

Somebody in the Department of Commerce recently sat down to

enumerate the military uses of wood, and made up the following "partial list": airplanes, armories, armracks, assault boats, assault bridges, ax handles, barges, barracks, barrels, batteries, bedsteads, blimp hangars, blocks, bowls, boxcars, boxes, bridge timbers, broom handles, brush handles, buoys, busses, cabinets, cantonments, cargo planes, cars, carts, cases, chairs, chapels, chests, classrooms, conduits, containers, cots, crates, crossarms, crutches, culverts, decking, decoys, derricks, excelsior, ferryboats, filing cabinets, fire stations, flagstaffs, flares, flooring, foot bridges, furniture, garages, gliders, gunstocks, guardhouses, gutters, hangars, hinges, hospitals, housing, huts, insulation, jeeps, ladders, landing boats, latrines, launches, laundry steam plants, lifeboats, life rafts, lockers, machine shops, mallets, map scales, mess halls, mine layers, mine sweepers, models, munition plants, musical instruments, paddles, parachute buildings, partitions, patterns, paving blocks, pencils, piling, pipe, platforms, plugs, poles, pontoons, posts, propellers, racks, radios and apparatus, rafts, railroad cars, railroad ties, ramps, reels, refrigerators, rescue boats, rules, saddles, scaffolding, school buildings, shelves, shipyards, shoe lasts, shovels, skiffs, skis, snowshoes, stables, stools, storage bins, stretchers, sub chasers, switchboards, tables, tanks, tent frames, tent pegs, tongue depressors, tools, torpedo boats, towers, trailers, trainer planes, transports, trays, tripods, truck bodies, tugs, vats, wagons, warehouses.

No wonder a foremost authority described lumber as "the most vital material for the successful prosecution of the war," and the lumber industry as "the most important war industry in the country." And the accuracy of this statement is shown by the fact that in the winning of World War II our armed forces used a greater tonnage of wood than of steel.

Such enormous use of wood was due to two causes: the deliberate effort to substitute wood wherever possible for scarce strategic material, and the fact that this was by far the biggest Army we ever raised. Some statistician has figured out that it requires the product of five trees to equip and maintain each man in the armed forces. One tree provides his living quarters, mess hall and other buildings in the training camp. Another furnishes the wooden boxes and crates that keep him supplied with food, clothing, guns and tanks. The remaining three go into miscellaneous purposes: bombers and battleships and pontoon bridges and trucks and bunks and lockers and tent pegs and cellulose for high explosives and scores of other necessary things.

Official recognition of the importance of wood in war was indicated by the Carpentry, Cabinetmaking, Mechanics and Wood Finishing Schools maintained by the Quartermaster Replacement Training Centers. The Army recognizes the carpenter as an indispensable specialist; there are innumerable things to be built of wood, and only the trained soldier-carpenter knows how to build them. At the carpentry schools the trainees learn to build anything—from a box to a barracks, and in learning by doing they crowd a wide technical education into a brief period. The soldier-carpenters emerge prepared to take a vital place in the war effort. Armed with saw and hammer instead of rifle and bayonet, these skilled men accompany the Army wherever it goes and build for it the things of wood that it needs—chicken coop, truck body or emergency hospital. The Army regards the trained khaki-clad carpenter specialists as among the most valuable men in uniform.

Also the Army, in preparing for World War II, trained a number of forestry engineer companies to manufacture needed lumber from the timber of occupied countries. During World War I the Twentieth Engineers operated sawmills in France and produced for the Allied armies millions of feet of lumber which otherwise would have taken valuable shipping space from this side. In World War II the forestry companies—"sawmillers" they preferred to be called—were inducted at the Engineer Unit Training Center at Camp Claiborne, Louisiana, with logging operations in the near-by National Forest. Officers and noncoms from the country's sawmills and logging camps acted as instructors, and they transformed raw recruits into skilled lumber operators at a rapid rate. These specially trained engineering units accompanied the invading armies. The circular sawmills and logging tractors followed the guns and tanks, and the forward movement of the troops was furthered by the lumber and timbers the sawmiller companies produced for them then and there.

The American lumber industry's contribution to the nation's war effort began long before Pearl Harbor. Its service started with the "defense" program during the late summer of 1940, when it was decided to build up our Army to modern proportions. Before recruiting the first draft of 1,500,000 men could be launched there had to be some place to house them.

The preparedness program had been postponed a long time but, once it was decided on, the War Department was in a frenzy to get

it under way instantly. Plans for the first group of cantonments were rushed through almost overnight. Countless buildings were needed for the sudden and tremendous expansion of our munitions works. To construct the camps and factories and warehouses various governmental agencies embarked on what has been aptly described as "a blitzkrieg of building," the largest carpentry job in history. It demanded immediate delivery of billions of feet of lumber, but the lumbermen were equal to the occasion. The lumber was furnished and furnished promptly and with a minimum of confusion. Within six months the lumber industry delivered more than two billion feet of lumber to Army camp projects. It won public commendation for its performance, and it well deserved it.

By the end of 1940 the building program had got well started. In the next year it proceeded at an accelerated rate. So great was it that there was consumed directly and indirectly for national defense close to 24 billion feet of lumber, about 73 percent of the year's production. It was a lumberman's nightmare of production and shipment. As one of the War Department's purchasing officers later said to a group of lumbermen: "Our delivery requirements have been completely unreasonable, and the advance information given the industry has been totally inadequate. We have called upon you for unusual grades and sizes, for delivery at a moment's notice. We have changed shipping instructions and our general requirements. Regardless of these handicaps, you have done a wonderful job." Or, as another Army officer said to the lumbermen about the same time: "You whipped time with timber; you delivered the woods."

Nobody unfamiliar with the complexities of the lumber business —and the intricacies and involutions of governmental purchasing procedure—can have any idea of the handicaps under which lumbermen in those early days of Army buying established the record which merited that high praise. The first defense-program purchase was 200 million feet for four new Army camps. According to the usual system of Army purchasing, formal invitations to bid were sent to the lumber firms on the Engineer Corps' list, and the bids were then compiled in the Corps' office in the usual way. But this was not a usual piece of business. The purchasing office soon found itself engulfed in a sea of paper work that almost swamped it.

Two hundred fifty thousand prices were submitted on all the various items of lumber desired. More than three hundred thousand

sheets of paper were used in the compilation of the bids. Thirty accountants worked night and day for ten days merely to get the bids into such shape that awards could be made. Then it required twenty typists to write the telegrams of award. Army purchasing practice required an "abstract sheet" covering bids and awards—and it was five feet wide and one hundred twenty feet long! The office finally placed the orders and got the lumber on the jobs so the carpenters could start to work, but it was completely disorganized and exhausted by the monumental effort.

Aside from the difficulties arising from adherence to old-fashioned Army red-tape methods of buying, the purchasing plans of the Government were complicated by the fact that so many different agencies were thrust suddenly into the market for lumber. In addition to the Army, the Navy had a building program of its own. The Maritime Commission was buying lots of lumber. The Lend-Lease program was calling for material to be sent abroad. Various contractors and subcontractors entrusted with Government building jobs were buying their lumber direct from the mills and dealers. Within a short while a chaos ensued in which the various agencies were competing with one another—and sometimes within themselves—for the same lumber. Obviously this could not be endured.

As a remedy, after some study and consultation, a Central Procurement Agency was established within the Army Corps of Engineers. It assumed the duty of buying all the lumber required by all the various governmental agencies and many of the contractors, and quickly became the largest single purchaser of lumber in the world's history. It bought something like 20,000 carloads of lumber a month and spent more than a million dollars a day.

From their bewildering experience with the first four Army camps, the lumber buyers of the Corps knew that they could not purchase this gigantic volume efficiently through the old, established system. Accordingly they evolved an entirely new approach. After due deliberation they hit on the plan of holding auctions or lettings at various centrally located points throughout the country, principally in the producing sections, to which the lumbermen of the regions were invited. When the lumbermen were assembled at such a letting announcements would be made regarding quantities of lumber desired for various jobs, and descriptive lists distributed. The men who had the lumber wrote out on slips of paper the quantity they could fur-

nish and the price at which they were willing to sell it; these bids were collected and tabulated then and there; and within a half-hour the successful bidders would be declared. When the letting was over, generally in two or three days, the Procuring Agency knew how much lumber it had bought and the lumbermen knew how much they had sold, what they would get for it and when and where it should be delivered. It was the greatest simplification of purchasing practices ever achieved in any of the activities of the Government, the greatest eliminator of red tape and expense in buying.

After World War II the Central Procurement Agency was continued as an efficient peacetime agency for the acquisition of lumber for the armed forces; and, since the advent of the Korean emergency, it has been operating smoothly and effectively in buying the billions of feet of lumber needed in connection with our accelerated defense program.

In World War II activities lumber was seen everywhere—sometimes in the most unexpected places. Battleships have wooden decks, and so have aircraft carriers. Freighters, while being built, are surrounded by a web of wooden scaffolding that eats up about fifteen or twenty carloads of lumber. Torpedo boats are built of wood, airplane propellers are turned from laminated wood. From flagpoles and tent pegs to cots and stretchers, the Army uses wood in large and small quantities. The troops in Iceland were equipped with skis—made of wood; the forces could not have been maintained in the South Pacific without the wooden boxes in which their supplies—rations and cartridges—were shipped. Soldiers in both regions—in tropic heat and arctic cold—were protected from the elements by the Army "hutments," the igloolike prefabricated houses made in this country and shipped knocked-down to the point of use. The hutment was sixteen feet wide and thirty-six feet long and housed sixteen men. It was built of plywood attached to curved laminated wood arches. The arches were ribs of five-ply wood, glued to shape, and the glue-plus-wood constructions made each arch a single strong unit that held its shape.

No opportunity was overlooked to use wood in order to save critical materials. An inconspicuous and relatively small example was the Army's use of wood-cored rubber heels for soldiers' shoes. The wood core consisted of a small piece of perforated U-shaped hardwood plywood. In molding the heels the small holes in the wood permitted the molten rubber to flow through, resulting in a secure

bond. This form of construction saved one and one-fourth ounces of rubber in each heel. In an Army of eight million men it saved a lot of rubber—and it took a lot of plywood. In such large-scale production, any unit saving of strategic material is multiplied enormously in the aggregate. For instance, it was estimated that using wood for folding chairs for the Army saved over 10,000 tons of steel in one year. Other thousands of tons of steel were saved by using wood for trucks and trailers, cots and lockers and many other purposes. In all, the conversion to wood of products (military and civilian) previously made of metal released to war service during one year a total of more than five million tons of metal.

Not only directly but indirectly did wood contribute to winning the war. Take, for example, wooden tanks. Smokeless powder, synthetic rubber, the priceless sulfa drugs, the food the Army eats—all these, and many more essential wartime supplies, are at some stage of manufacture processed in wooden tanks. Production of tanks quadrupled the first year of the war—and kept on going up. During 1943 170,000,000 feet of lumber—and very high-grade lumber—went into making them. For many purposes, especially where corrosive chemicals are used in the processing, wood is the indispensable tank material. It resists both heat and chemicals better than metal; there is no metallic contamination; no turbidity. Strangely enough, steel itself is cleaned in wood tanks preparatory to rolling; the chemicals that clean it would at the same time corrode a steel tank.

But wood served not only in the background of the war effort, in housing and in industrial uses. It was in the very front line of action —on land, in the air, on the sea.

One of the most highly publicized examples was afforded by the PT boat which played such a valiant role in the early activities around the Philippines and continued to take an active part in the naval fighting. It was nothing much more than an armed speedboat, built of a plywood skin on a wooden frame. It was about seventy feet long and twenty feet wide, was powered by three Packard engines and carried two machine guns and two torpedo tubes. Its protection against enemy fire was strictly zero; its usefulness consisted in its capacity for hit-and-run fighting, based on speed and elusiveness. Plywood offers a minimum of protection against a .50 machine-gun bullet, but makes a speedy and maneuverable boat—whether for fighting or for pleasure

riding. The work of the all-wood PT boats looms large as the history of this war is written.

These boats made such an appeal to popular imagination as to obscure the wonderfully wide variety of uses to which wood was put in other marine craft. Plywood was used not only in the patrol boats, but also in pontoons, lifeboats, tugs, mine sweepers, barges and even in the biggest freighters. Plywood panels to the extent of ten thousand square feet, for instance, went into each of the Liberty ships launched at the Kaiser yards.

Aside from this use of plywood, lumber in its conventional form was utilized to a tremendous extent in building all sorts of ships and boats, both for the Navy and for civilian wartime purposes. The Navy has always used lots of wood, since the days of "iron men and wooden ships." Times and methods have changed, but wood has remained a Navy essential. In normal times the Navy uses around 500 million feet a year, but within a year after the beginning of the war its requirements increased by something like 400 percent.

The Navy's uses of lumber cover a wide range—huge pine or fir timbers for dry docks, red gum for tongue depressors for the Bureau of Medicine and Surgery, cypress for hull planking and for casket shipping cases, white oak for keels and frames and for breech-boring blocks, mahogany for the PT's, ash for oars, and so on. The largest consumer of lumber in the Navy is the Bureau of Yards and Docks, which constructs all the shore buildings, such as piers, wharves, dry docks, storage facilities, etc. The Bureau of Ships builds new vessels, maintains and repairs them and their shore facilities. The Coast Guard, the Marine Corps and other bureaus and branches of the Navy all use more or less lumber.

About 85 percent of the Navy's lumber purchases are softwoods. Of the species used, Southern pine and Douglas fir are the leaders, with Southern pine's total volume slightly the larger. The most important use of these woods is in naval housing, warehouse and dry-dock repair and maintenance, hull planking, frames and keels. The softwoods provide most of the material for masts, spars and booms, and large quantities go also for cribbing, shoring and staging, as well as for boxes, crating and heavy shipping cases. Of the hardwoods, white oak is the principal species called for, its use being highly specialized. In small-boat building it is the favorite for frames, ribs,

keels, deadwood knees and some of the heavy planking. Nothing equals it for breech-boring blocks—the wooden blocks used to support the bits in boring out the barrels of the big guns. Some oak is also used for heavy shoring and cribbing. Cypress has always been a favorite wood with shipbuilders, and the Navy takes large quantities of it.

Among those contributing to the war effort by supplying white oak needed for ship timbers was President Roosevelt. Mr. Roosevelt's farm near Hyde Park had timber growing on a good proportion of its 1,500 acres and he was a timber farmer on a commercial basis, harvesting as well as planting. In the spring of 1942 he had his stand examined by an expert forester with the idea of harvesting the mature, merchantable trees—particularly the oaks suitable to cutting into ship timbers. The total number of trees harvested was 1,335, and several hundred thousand feet of shipbuilding material were produced by the sawmill in Connecticut to which the Presidential timber was sold.

Shipbuilding would seem the exclusive province of naval branches of our government, but the Army too engaged in considerable building of watercraft. Early in 1943 it built a fleet of 500 wooden tank barges, 21 towboats and 100 tugs to step up the flow of oil to the East. The Army also built assault boats, pontoons and other types of craft made of plywood or lumber.

The incidental building of boats, however, was the Army's smallest use of wood. By all odds the greatest, of course, was for the construction of the many, many camps of the troops in training, the building of munitions plants which sprang up like mushrooms all over the country, and the housing of workers. The lumber so used ran into many billions of feet, mostly softwoods. Hardly had the construction program been completed when there began a steady and tremendous increase in the use of lumber to box and crate ammunition, guns and other munitions for shipment to the battle fronts abroad. The volume needed seems almost incredible, until the unique nature and magnitude of World War II is considered.

A modern army is an army of movement. It does not sit quietly at home and wait for something to turn up. It goes places—and when it goes it must take with it all the guns and ammunition and supplies it needs. Everything a modern army carries with it is packed in wood. The boxes and crates are specially designed to get increased strength with decreased quantities of lumber, but even so it takes a lot of

lumber to move all the material required for an army of invasion. A 90-mm. gun weighs over 22,000 pounds, crated, and occupies nearly 1,300 cubic feet. A packing case containing a 155-mm. howitzer weighs 12,500 pounds and occupies 500 cubic feet. The crate for a half-track personnel carrier requires about 2,000 board feet of lumber. Every jeep takes more than 200 feet for crating. A crate for a tractor is as big as a small house. Just to equip a 100-truck unit of the Army, 34,000 parts must be shipped in 249 boxes. Food is packed in wooden boxes; so is the equally vital ammunition for the guns. Some of the boxes must be watertight, so they may be floated ashore through the surf by landing parties. When our invasion army landed in Africa they took with them 700,000 different items of equipment—everything from bullets to bulldozers—and they were all packed in wood. That meant millions of feet of lumber on the front line in Africa. Without that lumber the landing and the conquest of Tunisia would have been impossible.

Commenting on the part played by wood in the African invasion, General Clay, assistant chief of staff for materials, said: "Everything from huge howitzers to foodstuffs, walky-talkies and thousands upon thousands of shells came packed in wood—and much of that material, such as gunstocks, was made of wood. As our troops pressed forward, other troops in the rear areas were salvaging wood. Lumber was so scarce that it was treated with nearly the same care as the supplies it had harbored. Not a scrap of wood went to waste. It was converted into shelters, tables and antiaircraft gun platforms."

Even the fighting aircraft up in the air depend on the lowly wooden box to stay in action. Fighter planes for overseas service, because of their limited cruising range, have to be shipped in crates, each crate requiring as much lumber as a four-room house. Most of the big bombers can fly across to the fighting fronts under their own power, but they can't carry with them all the maintenance, repair and service parts they need—and without such parts they are helpless. One of the incidental wartime uses of lumber which consume in the aggregate a large amount of material is the boxing and crating of these spare engines and other parts.

Important in the activities of every bomber manufacturing plant is the crating and shipping shop, a factory in itself. A typical shop during wartime will use a half-million feet of lumber every month, in addition to large quantities of plywood. Spare parts for shipment

abroad are generally packed in two crates, the inner one about three feet wide, three feet deep and seven feet long, made of plywood with bracing of one-by-two's. These inner crates are carefully designed to get maximum strength with minimum weight. In their overseas journey they are enclosed in an outer crate made of inch lumber with a double layer for the top and skids on the bottom. When the ocean voyage is concluded the protective outer crate is removed and the lighter inner crate is flown to the ultimate destination in transport planes.

Under prewar conditions the annual consumption of lumber for boxes and crating in the United States ran to about three billion feet per year. This consumption jumped rapidly during the war years: to five billion feet in 1941; nine billion in 1942; fourteen billion in 1943; fifteen billion in 1944; and twelve billion in 1945. During the past four years the total consumption of lumber for boxes and crates has averaged between four and five billion feet per year; but under the impact of the current defense program it is rapidly mounting again.

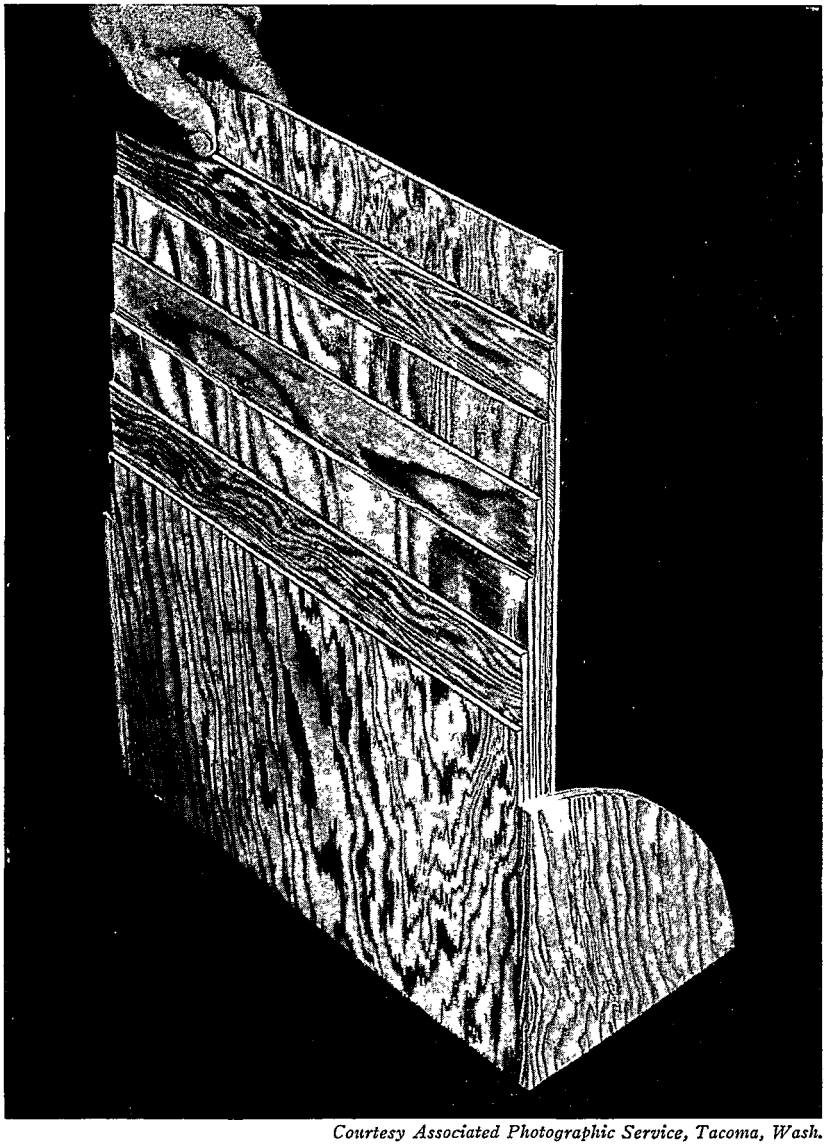
The enormous wartime call for hardwood and softwood boards of all species for boxing and crating made it increasingly hard to buy lumber for other purposes just as essential. But those other purposes had to be served, varied and multitudinous as they were. They were all important in the war—and they all used a lot of lumber.

One of the most notable results from the Army's decision to substitute wood for steel in building its truck and trailer bodies was an immediate new demand for a million feet of hardwood—mainly oak—lumber every day. With all the other demands on it, the hardwood industry had a hard time supplying this demand—but it did it.

Other millions, many millions, of feet of hardwoods went into the manufacture of bed-bunks for soldiers to sleep in. The frames were of hardwood lumber and the suitable supply was well-nigh exhausted at the peak of the bunk-building period.

The single item of trunks or lockers consumed additional millions of feet of lumber, also large quantities of plywood.

In the air wood rendered some of its most sensational aid to the Allied cause. It showed a complete swing around the circle in aircraft manufacture. At the time of World War I all airplanes were built largely of wood, and spruce was accepted as ideal on account of its combination of strength with light weight. The Army was entrusted with the responsibility of ensuring a plentiful supply. A Spruce



Courtesy Associated Photographic Service, Tacoma, Wash.

CROSSBAND PLYWOOD SECTION

Cross-banding of the grain of alternate layers of wood is the secret to the manufacture and physical characteristics of Douglas fir plywood. The panels merely are constructed of thin sheets (veneers) of wood with the grain of each ply at right angles to the one above and below. Then these plies are bonded together to form a panel that is pound for pound stronger than steel. Plywood is virtually puncture-proof, split-proof—yet easy to cut to desired sizes. This view shows a fir plywood counter display of one-inch, seven-ply plywood cut away to show the direction of grain in alternate plies. Legs are of ⅜-inch, three-ply plywood.



TYPES OF EQUIPMENT USED FOR TREATING LUMBER WITH CHEMICAL SOLUTIONS TO PREVENT STAINING, ETC.

wood, but it takes time and trouble to get them. The columns in the Douglas plant are of laminated construction, built of glued-up one-inch boards, and they were furnished with a minimum of delay. This plant featured the use of lumber in numerous other ways, including wooden window sash throughout and about five thousand feet of underground water mains built of wood.

Since World War II Teco's system of construction has branched out so that today it is used not only in all types of light and heavy frame buildings but also to a great extent in the home-building field, particularly in the one-story type of homes. More than fifty thousand housing units built by private, military and public housing agencies have used Teco trussed rafters in their roofing systems. This new development is popular because all loads are carried on the trusses and sidewalls, thus permitting the use of nonbearing interior partitions that can be installed after the floors are laid and can be placed in position to suit the owners' tastes, thus providing great flexibility of interior arrangements.

In addition to educating designers and builders to better building methods through the use of Teco connectors, the Timber Engineering Company has introduced Trip-L-Grip framing anchors for secondary wood construction; Colpres 10 glue, a quick-setting adhesive for use in furniture and other fabricated wood products, which was developed in the company's laboratory; and for teachers, students and wood technologists it provides Wood Study Kits. In 1943 the company established a wood chemistry and wood products development laboratory in Washington, D.C., an important activity which is treated more extensively in a later chapter.

In the current defense effort the Timber Engineering Company is again rendering helpful services to the defense agencies, not only in the construction field but in research. Its laboratory, conveniently located in Washington, is carrying on a wide variety of research projects for the defense agencies and for private companies in a constant effort to achieve better utilization of wood and forest products.

Glued Laminated Timbers

The vast construction activities incident to World War II gave tremendous impetus to the use and acceptance of the principle of

glued laminated construction, which was in its infancy ten years ago but which has developed into a lusty young giant within the past decade. Glued timbers and trusses, those shop-grown combinations of wood and adhesive, not only possess great structural strength and adaptability but lend a new enchantment to timber construction that cannot be matched in steel or stone.

Glued timbers, although comparatively new in this country, have been used in Europe for more than forty years, and there they have conclusively proved to have a strength and durability that has recommended a much wider field of use. About fifteen years ago the Forest Products Laboratory sent a representative to Europe who thoroughly investigated many existing structures, and in 1939 the laboratory announced the outcome of its successful research. At first the adoption of the idea in this country was slow; but, stimulated by the scarcity of metals in World War II, glued laminated timber construction expanded rapidly, and today there are thousands upon thousands of glued timbers in permanent use.

During the past seven years the Forest Products Laboratory, with the aid of industrial laminators and lumber associations, has carried on an extensive program of testing and analysis on glued timbers. As a result of this research there is now available a scientific basis for rational and factual specifications and working stresses for glued timbers. The West Coast Lumbermen's Association of Portland, Oregon, has just issued a set of standards for such material made of Douglas fir; and the Southern Pine Association of New Orleans is now drawing up similar standards for Southern pine.

A most important factor in the extensive expansion of glued timber construction has been the organization of a number of laminating plants throughout the United States which specialize in the production of standardized and custom-built timbers. The proportions to which this industry has grown are astonishing. One such plant covers an area of more than twenty acres. In these plants there is a complete array of automatic machines such as scarfers, glue spreaders, planers, sanders, resaws, and all the modern equipment of jigs, clamps, air tools and cranes that bring the machine age to timber fabrication and lamination.

During the war years the Government established pilot plants to explore methods of laminating timbers with glue to withstand repeated immersions or long-continued soaking in fresh or salt water.

Investigations were entirely successful, and glues and gluing processes are now available for the commercial production of the ribs, deck beams and stem-keel-sternpost assemblies of glued laminated wood in oak, fir and Southern pine that will endure under the most severe marine exposure. Mine sweepers are now being built of wood in various sizes up to 165 feet in length. Wood, of course, is non-magnetic and, as the fastenings can be of bronze, this has proved to be an ideal method of construction for the exacting requirements of this type of vessels.

Glued timbers make strong and beautiful truss members, arches, columns, girders and light ribs for churches, schools, auditoriums, warehouses, recreational centers and all those structures where timber can be used at all. Exposed glued arches or girders may eliminate costly ceilings and coverings and so be more economical than those metal or concrete members which must be placed under wraps to hide their hard and cold appearance.

Ground area permitting, modern schools trend toward low, one-story buildings that eliminate stairways and their attending hazards. Classrooms are generally arranged with widths of 22 to 28 feet, with adjoining corridors five feet or more in width. Glued timbers spaced at about eight-foot centers and decked with two-inch plank laid solid make a most excellent classroom roof. Decking on the top side should be covered with insulation and roofing, with acoustical ceiling material placed on the under side. Timbers should be left exposed in the classroom. Glued arches make excellent roof supports for other school buildings such as chapels, auditoriums, drill halls and gymnasiums.

Timber bridges are being built in many styles and with varied spans, with the material best suited, for foot or highway bridges with spans as long as 200 feet. Old-time timber highway bridges were covered over to keep the structural timbers dry, and such covered bridges have lasted without deterioration for many decades. Present practice in bridge building is to forego housing, with its excessive cost and weight, and to pressure-treat timbers with preservatives. Treated bridges have a life expectancy of 30 to 50 years. Sawed and glued bridge timbers treat well with either oil or water-borne preservatives.

Glued treated arches, either two or three-hinged, make good bridge supports where the site provides high clearance and rocky

banks. No structure can have a greater beauty than the rainbow arches, extending in one graceful sweep from shore to shore. Large glued treated girders make excellent low-clearance bridge spans up to sixty feet. Assembly and erection costs of girder bridges are low.

Pony bridges, using bowstring timber trusses with glued top and bottom chords, make sturdy structures. Curved glued top chords take treatment well. At Oswego, New York, a 90-foot glued creosote pressure-treated pony bridge for heavy highway traffic was erected in 1945—thought to be the first of this type. At Bohemia, Oregon, there was installed in 1949 a two-hinged low-rise arch glued creosote pressure-treated railroad bridge with a span of 120 feet.

Over Mill Creek in Oregon a retort pressure-treated two-hinged glued arch bridge of 100-feet span was constructed in 1947. Five types of timbers were used: Glued arches, salt-treated after laminating; glued posts, salt-treated before laminating; creosote treated laminated deck; painted handrails; and untreated and unpainted approaches. There is being constructed across the Kootenai River in Montana a timber bridge with five 100-foot spans. Piers are timber cribs, and deck spans consist of two trusses with glued laminated chords. All timbers, including chords, are pressure-treated with creosote. Similar bridges are being built throughout the United States.

The light, curved glued timber-ribs used so long and so extensively as barn rafters make good supports for all manner of moderate-sized structures, such as warehouses, stores theaters and arenas. Of late years curved roofs have become stylish; structures are rounding out to a new beauty, and timber-ribs well suit the new trend. Of curved Gothic shape, the ribs are designed as true three-hinged arches and used at rafter spacings. They rise in one clear sweep from floor to ridge and serve as both wall studs and roof rafters. Expensive eave construction is avoided, and ribs are so easy to erect that structures rise as if by magic. To timber-ribs are added sheathing or wood strips and roofing. Timber-ribs best suit buildings with high-rise roofs and moderate spans, and produce strong barns with roomy unobstructed haylofts.

Glued timbers are conducive to greater fire safety, since they involve larger sizes and fewer connections. Persons who have not observed the action of fire on glued timbers may fear that glue lines will melt and timbers quickly delaminate under intense heat, but tests prove that such fears are unwarranted.

Fire tests prove that casein or phenolic glue lines do not break down in fires until the surrounding wood collapses under combustion. Casein glue will not flame or char more readily than wood, nor will it sustain combustion. Resorcinol glues have their liquid content volatilized during the curing operation, and the remainder will not sustain combustion. It is well established that glued timbers will have laminations held together even after the wood is charred. Glued timbers under fire perform much as solid wood. On faces where glue lines are exposed, cracks occur along the glue lines in the charred portions much as they do along seasoning checks in sawed timbers, but glued timbers do not delaminate.

Glued timbers are manufactured as interior and exterior types. Interior glued timbers have water-resistant glue lines, and are strong and durable in protected service conditions of low humidity. They will withstand assembly and erection weather hazards, but not extended exposure in extreme service conditions. Exterior glued timbers have waterproof glue lines and will safely withstand extreme service conditions of weather or soakings in fresh or salt water. Exterior timbers can be given preservative treatments.

Those picturesque windmills in San Francisco which once pumped water from Golden Gate Park and which now stand by for photographers and for emergency use, needed a new spar a few years ago. A glued laminated member 114 feet long was fabricated in Portland, Oregon, given two applications of hot linseed oil and shipped by rail to the job site. Many large dredge spuds—those legs that anchor dredges to river bottom against the drag of wind and current—have been glued laminated timbers with waterproof glue lines. Such timbers are up to 30 inches square and 90 feet long.

It is the confident expectation of those in the industry that in the future glued laminated timbers will progressively occupy a more important position in timber construction and wood utilization. Timbers will become larger and larger, timber spans will become longer and longer—and wood will have greatly extended its field of usefulness.

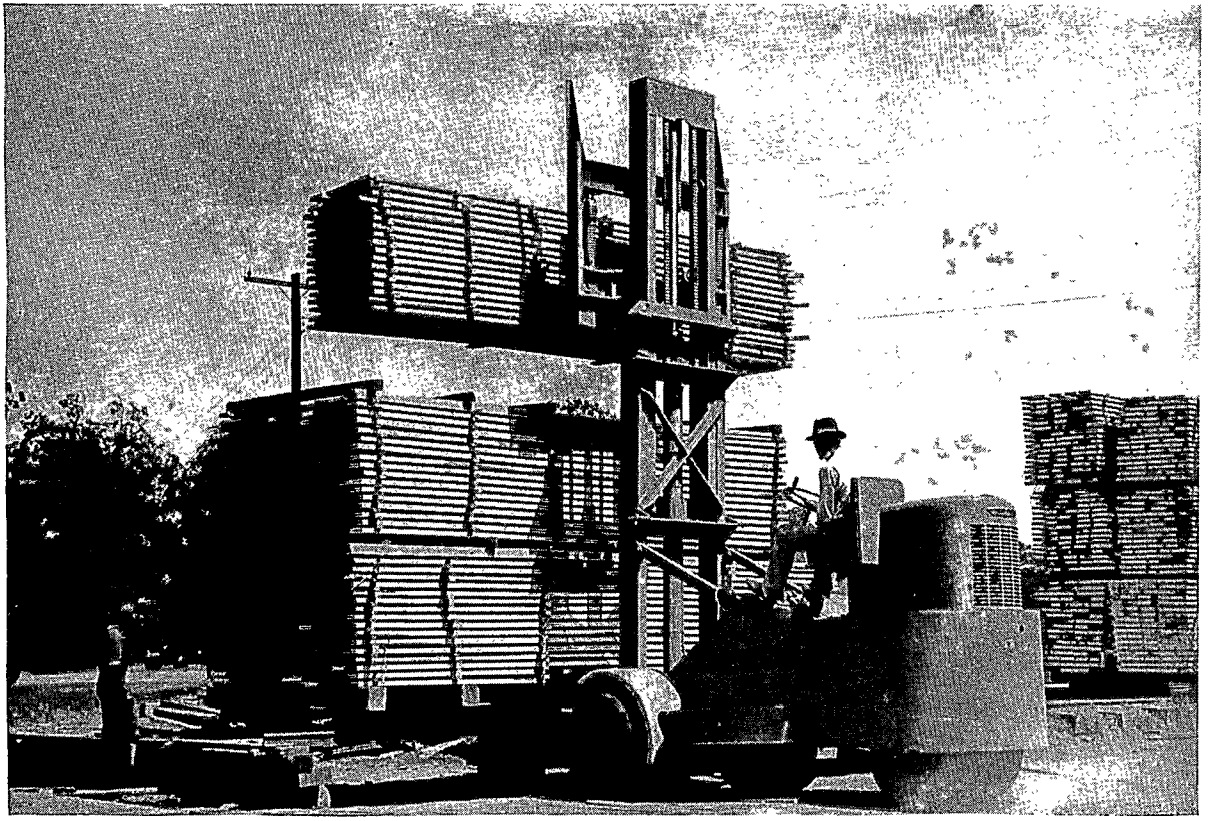
Demonstration of the adaptability of wood to the most modern forms of construction has resulted in a much greater demand by architects and engineers for technical information about its physical and mechanical properties. In spite of the fact that wood is one of the oldest and most familiar of all materials, it is often used by con-

struction engineers not sufficiently familiar with its characteristics, the basis for its working stresses, or the factors controlling the design of timber structures. This is the direct result of the fact that most engineering schools and colleges have neglected the teaching of wood technology or the basic principles of wood construction. Consequently the graduates, while well informed in the other phases of construction, have too often had to resort to rule-of-thumb methods in designing timber structures—frequently playing safe by specifying material heavier than was actually required. Information regarding wood and its qualities has been available from the lumber associations, and from such institutions as the Forest Products Laboratory, but architects and contractors have not always availed themselves of it.

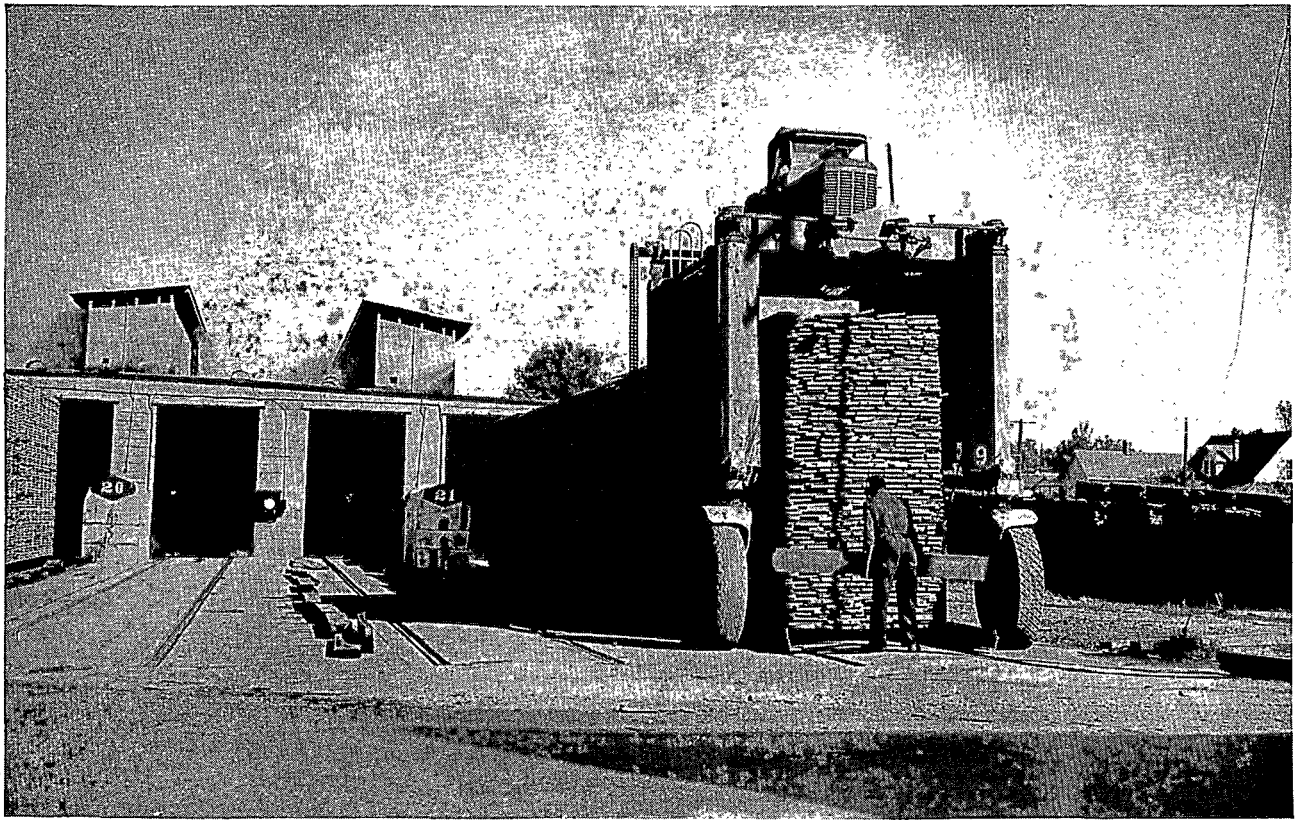
In recognition of the rebirth of wood as an engineering material, some of the more progressive technical schools are now teaching modern scientific design in wood. There is, however, still vast room for improvement; great need exists for more intensified, scientific education in fundamental principles.

The most complete and encyclopedic book on the subject is the *Wood Structural Design Data*, prepared by R. G. Kimbell, technical director of the National Lumber Manufacturers Association, and published by that association. Based mainly on research and experiments of the Forest Products Laboratory, supplemented by detailed rules for application, tabulated computations, design charts and other time-saving items, it covers practically everything important to wood designers and users.

Similar publications of engineering data are now available from some of the regional lumber associations, paying particular attention to the properties of the local species. They waste no time or space on sales promotion but provide up-to-date and exact technical data on wood construction—the kind of facts that permit precision instead of guesswork in timber design. Such books were practically unknown twenty years ago, but are found in more and more wood-use offices every year as lumber becomes more generally recognized as an engineering material.



LIFT TRUCK USED IN MODERN LUMBER YARD



STRADDLE-TYPE TRUCK CARRIES BIG LOADS OF LUMBER TO DRY KILNS

Chapter XIV

ADVANCES IN TECHNIQUE

SINCE the first American sawmill was started more than three hundred years ago amazing strides have been taken in equipment and technique—from the crude early sash mills to the circular saw (not introduced until the early nineteenth century) and from the circular saw to the band saw.

Manufacturers of band sawmills have been constantly improving the efficiency of their machinery during recent years and the quality of the lumber it produces. Mills are now equipped with ball bearings and roller bearings, reducing friction to a minimum. They use lighter-gauge saws and so still further reduce the waste in sawdust. For handling the heavy logs common to West Coast operations mills of heavier design have been introduced, with increased speed and power.

One of the greatest mechanical advances in sawmilling technique has been in the equipment employed on the carriage. The automatic setworks, operated by electric power, make it possible to adjust the position of the log instantly, accurately and more rapidly than by manpower. Another improvement on the carriage is the use of compressed air to manipulate the dogs which hold the log in position. These air-dogs are faster and hold the log more firmly, and by their use one man may operate a saw carriage, where it once took three men.

The productivity of the band mill has been speeded up by electric power, on operations justifying its installation. This has been particularly in evidence on the Pacific Coast, where the size of the mills—and the size and variability of the logs—make flexibility of power especially advantageous. By substituting electric power for steam power these large mills can reduce the number of men employed in the power division of the operation, reduce maintenance cost through the elimination of belting and pulleys, increase the direct power and maintain a constant speed of operation during sawing.

One of the principal advantages of electric power is the easy control of the sawing speed. In the big mills it is sometimes desirable,

when sawing a particularly difficult log, to slow down from the customary 10,000 feet per minute to, say, 8,000 feet. In a steam-driven mill this involves shifting the saw-drive belt to a smaller pulley; but in an electric mill with a double-motor drive it can be done in an instant by merely pressing a button. One Pacific Coast mill reports saving $1,000 a month by installing a double-motor drive (which cost $3,000), what with the increased production, the elimination of wavy cuts in the lumber and the reduction of planing costs.

On the whole, it may be said that the modern band mill is an excellent piece of machinery which does not seem to leave much room for improvement—unless a genius devises some entirely new method of reducing the log to boards. The same cannot be said of the circular mill. Minor improvements in the way of strengthening structural features, increasing rigidity and decreasing the gauge of saws have been introduced, but it is still essentially the same as it was twenty or thirty years ago. Of course, the conditions under which the circular mill is usually employed are not ideal. In the nature of things, the portable sawmill, used so much by farmers and inexperienced operators, must be a simple and rugged piece of machinery which calls for a minimum of skill in its setup and operation. Its principal virtues are its simplicity and its portability. Within its limitations, it has done a good job and produced a large part of the nation's total output of lumber, but still it is by no means ideal.

To meet the obvious objections to it attempts have been made to popularize a portable band mill. Generally speaking, these mills have been efficient, making good lumber at a relatively low cost, but most of them have been "portable" in name only. Their operators have set them up in a permanent or semipermanent way, bringing the logs to the mill, instead of pursuing the truly portable-mill practice of taking the mill to successive locations in the timber. A small, inexpensive band mill which could be moved around and set up with the ease and economy of the present portable circular mill would be a valuable contribution to the lumber manufacturing industry of the lower production bracket.

In European countries, especially in Sweden, lumber is manufactured on a gang-saw type of sawmill which saws the entire log into boards at one operation. This type of mill has been introduced in this country to a limited extent, principally on the Pacific Coast, but has not achieved widespread acceptance among lumber manu-

facturers. With the increased cost of timber and labor, however, it appears that the gang-saw's possibilities for increased production and reduced waste and labor will be more thoroughly explored.

A phase of lumbering in which modern improvements have been longest in coming is the simple act of cutting down the tree, the first step in production. King Solomon's hewers of wood chopped down the cedars of Lebanon with axes—and through the centuries woodsmen have continued to chop down trees with axes. About sixty years ago the ax was supplemented by the crosscut saw, and since then the ax-saw combination has been universal. Minor improvements were made in them, but they remained primarily tools that accomplished their purpose through men's muscles. The machine age appeared to have overlooked tree-felling.

This oversight was more apparent than real. Machine-minded men have long pondered the possibility of bringing down trees with mechanical saws, and various attempts at devising them have been made. The task was difficult. Besides the basic problem of applying power efficiently to the reciprocating motion of the conventional crosscut saw, there was the even greater difficulty of supplying the power in portable form in the rough and isolated locations in which the saw would be used. For twenty years or more inventors have experimented with various devices, but as lumbermen seemed inclined to regard them with skepticism, progress was hardly discernible. The labor scarcity incident to the war, however, prompted interest in any kind of mechanism that might increase the output of the available labor, and the mechanical tree-felling saws made a place for themselves by their performance during the war years.

These saws are of two general types: the drag saw and the chain saw. The former consists of a rigid saw blade of conventional sort attached to a motor or engine which drives it back and forth as the old type of crosscut saw was pushed and pulled by muscle power. The chain saw employs an entirely new principle: an endless chain of saw teeth running around the perimeter of a rigid steel plate shaped approximately like a crosscut saw blade, the chain being driven by either a gasoline engine, electric power or compressed air. The engine-driven saw has a lightweight gasoline engine and saw made all together in compact, portable style, so that it may be moved readily from tree to tree by its two-man crew. The electric-driven saw has in place of the gasoline engine an electric motor which is connected by a de-

tachable rubber-covered cable with a generator mounted on a crawler-type tractor able to take this portable power plant wherever the saw is wanted. The portable air compressor is similarly mounted.

Obviously the practicability and efficiency of such saws vary with the species of timber, the lay of the land—and the skill of the user. On the whole, they have proved to be highly efficient in producing an increased supply of logs with fewer men. A Western operator reports that a three-man felling crew with a power saw can cut 100,000 feet of timber a day in mountainous country. At a recent demonstration of a chain saw on a Southern pine operation an inexperienced four-man crew felled and bucked in three and one-half hours as much timber as they had been cutting in four days with their crosscut saws. Another saw crew stated that they could cut four or five times as much timber with the chain saw as with the old crosscut saws.

The ability of power-driven saws to fell the very biggest timber was demonstrated recently when one of the largest redwood trees was dropped successfully by men of the Union Lumber Company at Fort Bragg, California. It was 334 feet high and 21 feet in diameter at the stump, scaling 140,800 feet—beyond the capacity of any saw of ordinary dimensions. The emergency was met by splicing together a 12-foot and a 10-foot blade for a machine of the dragsaw type. Three days were spent in preparing a falling layout to reduce breaking to a minimum, and the skillful fellers dropped the tree exactly in the intended path. The improvised 22-foot saw handled the cutting job without difficulty.

An incidental advantage of the power saws is the operators' ability to reduce the stump height and so eliminate that much waste. A large-scale study on a Western operation showed that the stumps averaged ten inches lower where the power saws were used—a saving in timber that can mount up into large figures quickly.

Some of the most radical and far-reaching changes in the technique of lumbering have been connected with logging methods—not merely in the equipment but in what might be called the philosophy. This alteration in the loggers' point of view was due largely to the studies of the United States Forest Service, in co-operation with such organizations as the Pacific Logging Congress and the Appalachian Hardwood Manufacturers, showing the dollars-and-cents advantages of selective logging. It was one thing to tell a lumberman that he

Division of soldier-lumberjacks was formed and sent into the woods of the Pacific Northwest to get it out, and their accomplishments have become a legend in the industry.

After the First World War came the era of the all-metal airplane, and wood sank into the background. With the new war, and the accompanying metal scarcities, there was a swingback to experimentation with wood. At first this was confined to trainer planes which would not see actual combat, but the British went a step farther and developed their history-making "Mosquito" bomber.

The "Mosquito," the standout aerial craft of the war, was a tribute to the availability and flexibility of wood. It was designed during the early days of the war by the officials and engineers of the DeHaviland Company in England, and it was in production twenty-two months after the idea of it was first conceived. The basic notion was not merely to conserve critical metals. The designers wanted to produce a bomber that needed no fighter-plane protection, and this they achieved, through the use of wood, by building one that flew more than 400 miles per hour and was able to outrun any of the fighters then in the air. Besides its ton bomb load, it was equipped with four 20-mm. cannon and four .303 machine guns, all mounted in the nose of the fuselage. No other bomber had such speed and concentrated fire power.

Engine cowlings and certain other vital parts of the Mosquito were made of metal, but principally it consisted of thin outer and inner skins of spruce or fir, "buttered" with casein glue and bonded to a core of balsa. Bullet holes could be repaired in a few minutes' time, as compared with the hours taken to plug holes in a metal plane. The Mosquito would float if shot into the sea. Ordinary carpenters and cabinetmakers could do the woodwork, and hundreds of furniture and other woodworking plants in England, Canada and the United States worked on subcontracts for component parts of the long-ranged fighting bombers which so savagely punished the munitions plants in Germany and France.

The famous Mosquito enjoyed no monopoly. Wood was used during World War II in forty-one different types of British airplanes, and in a large number of American combat planes as well as in gliders, trainer and cargo ships—the "flying boxcars." Technological knowledge of wood for heavier-than-air craft grew with its use. In 1917-1918 plywood had not reached its present stage of development, and the

wood—mostly spruce—was used principally for the wing beams and struts, with a treated fabric covering. Twenty-five years later the wing covering, and the body as well, were made of plywood, with the interior framework of either solid or glued-up wood parts.

The application of plywood to the building of the fuselage and wings became an art in itself. New types of thermoplastic adhesives permitted its use in a variety of processes of bag-molding under pressure, which gave smooth, curved outlines impossible by earlier methods. Overbuoyant journalists began to speak of "plastic airplanes." They were not, however, plastic airplanes; they were plywood airplanes, and should be recorded as such.

For the interior framework of the all-wood planes spruce was still preferred, but other woods were also utilized, including yellow poplar from the South and hemlock and noble fir in the West.

These other woods had not been used in aircraft until that time, but when the technologists found that they could successfully supplement the spruce supply, the manufacturing industry showed itself ready to produce the lumber needed in the unfamiliar sizes and specifications.

A dramatic and striking evidence of the industry's readiness to co-operate in any possible way to help win the war was provided by the Weyerhaeuser interests of the Northwest; they built a special sawmill in two weeks' time and opened up a new tract of mountain timber, just to supply fir aircraft lumber.

Producing aircraft stock is the work of a specialist; it cannot be cut from just any log. The Weyerhaeuser Company was one of the first to engage in this branch of the business, having taken early in 1940 contracts to supply aircraft lumber to the British Government. After Pearl Harbor special attention was given to the production of a maximum of such materials. Before we had been long in the war it became apparent that the supply of aircraft spruce would have to be augmented, and the Government appealed to all manufacturers to increase its production. In response to this appeal the Weyerhaeuser Company took the unusual step of building the special mill.

It was the fourth mill of the Weyerhaeuser Company at Longview, and its output consisted entirely of aircraft material—noble fir, Douglas fir and hemlock. The aircraft logs were cut into cants on the other mills, the cants were carefully selected as aircraft stock and then went

to the new mill to be sawed into the material needed by the factories fabricating the airplanes and parts.

Noble fir grows only in high altitudes and scattered stands. One of the Weyerhaeuser Company's first steps in the new enterprise was to survey their large timber holdings for it. Three stands were discovered—only one accessible to existent logging railroads. By combining and extending the railroads, sky-line skidder systems and Caterpillar tractors, the previously unreached logs were cut and brought to the plant at Longview.

In gliders too wood displayed its wartime adaptability. These gliders consisted of a fuselage of metal tubing and canvas, flying on wings made of thin veneer glued onto a glued-up wood frame. They were light and strong—and their big-scale production was based on the availability and the workability of wood. Troops conveyed in these gliders played a big part in the invasion of France and the ultimate winning of the war.

Lumber's performance in the war surprised many people—some in the industry itself and many more in the competitive industries. Many of the latter had in prewar years, by implication at least, sought to relegate lumber to the background as an outmoded and largely obsolete material. But when the war emergency broke and found us short of so many essential and strategic materials, no material was found better suited to the exigency or more ready to offer modern and highly perfected methods of use. The way in which Douglas fir, Southern pine and other structural timbers stepped into the breach and took over the construction service of steel was one of the outstanding industrial achievements of this war. It was not just an accident. It was the result of years of patient and painstaking work by the lumber manufacturers and associations, and they should be given full credit for their vision and their faith.

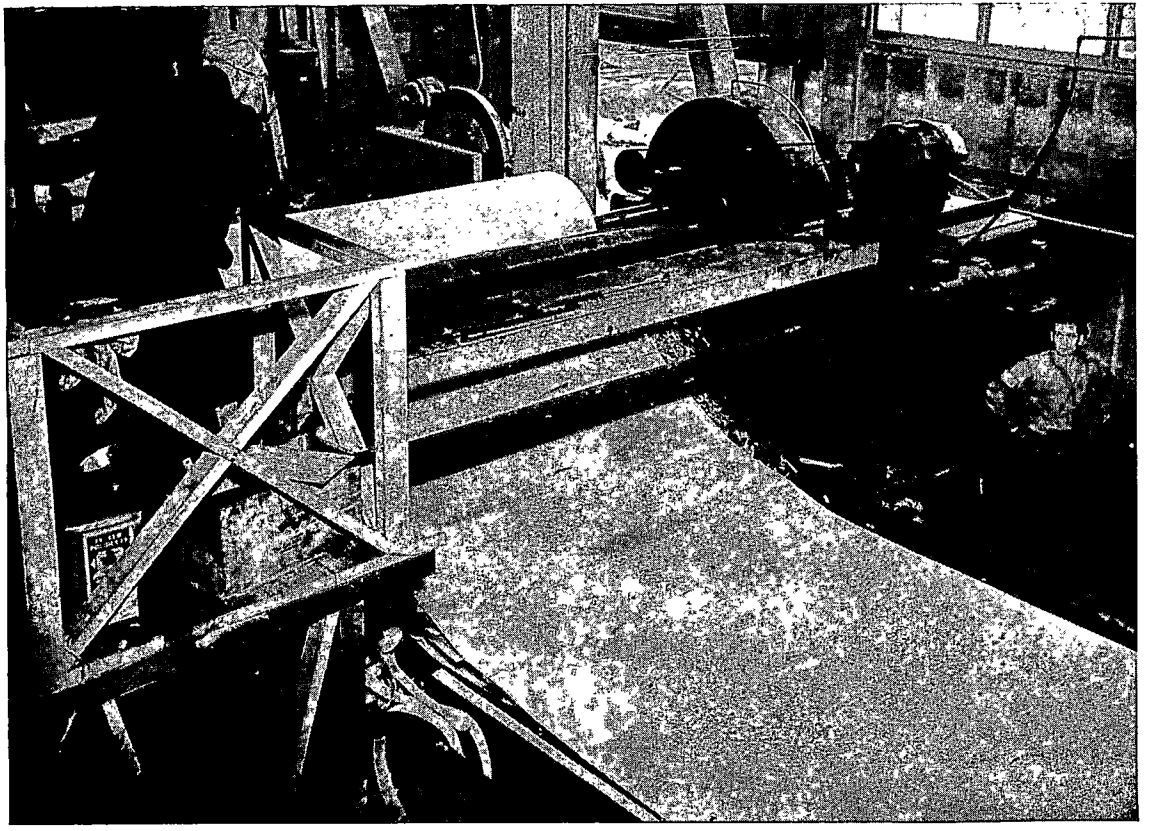
All over the country munitions factories and industrial plants contributing directly or indirectly to the war effort owed their existence to the fact that lumber and the modern methods of timber construction were available for their building. The big synthetic rubber plant at Baton Rouge could be completed and put into operation promptly because construction materials in wood—from timber trusses to wood sash—could be furnished at once in place of the scarcer critical materials. Aircraft factories and hangars, powder plants and chemical

plants sprang up in all parts of the United States with almost incredible speed because the lumber was there and the modern timber construction industry had the know-how.

The impact of war not only created a great quickening in the tempo of lumber demand; it also threw a wrench into the wheels of production. The sawmill industry's manpower was drained off by the draft and by the drift of workers to war industries. Operating supplies became scarce and hard to get. Regulations and restrictions mounted until many of the smaller mills were forced to quit. In the face of all these difficulties, despite its most conscientious efforts, the manufacturing industry was not able to maintain its 1942 production at a level equal to the year's consumption for war and essential civilian uses. In round figures, the consumption was about 42 billion feet and the production 36 billion. This mathematical difference of six billion feet was widely publicized in the daily press, and by some critics as a "shortage." The impression was created that the lumber industry, by so great a margin, had failed to meet the nation's requirements. In truth, there was no shortage at all. The industry answered all the military and important civilian needs without any deficiency, simply supplying out of its stocks on hand the difference between what it manufactured and what it shipped. That is what the stocks were for—to act as a cushion between production and consumption—and that is what they were used for.

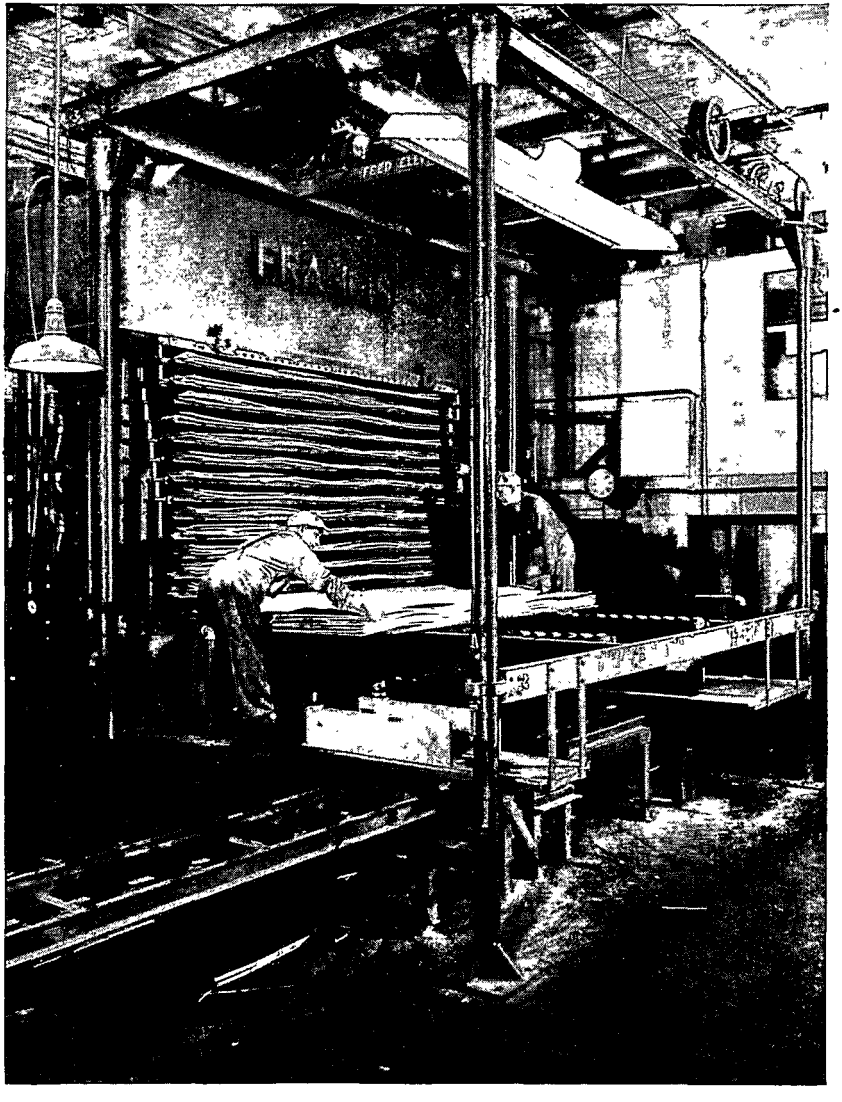
Through 1943 operating conditions were even more difficult, due to shortages of men and machinery. Most mills found it impossible to keep up to even 1942 levels, and many were forced to shut down. Production was 34 billion feet in 1943, with consumption reaching 37 billion. In 1944 and again in 1945 there was a slight excess of consumption over production; but by drawing on its inventory the industry was able to meet all the demands for lumber for wartime uses, and Colonel F. G. Sherrill, of the Army Engineers, was able to say: "Not a single job has been held up for lack of lumber, and not a ship has failed to clear port for want of lumber."

Recognition of lumber's vital importance came from the War Manpower Commission and Selective Service. Men needed to maintain production were eligible for exemption from military service by local draft boards. Most local boards, however, were primarily concerned with keeping up their quotas, and were strongly suspicious of all who



VENEER UNWINDING FROM GIANT LATHE

The continuous sheet of wood unwinds from the giant lathe almost like paper in a newspaper press. In this view can be seen the veneer on its way from the lathe to the trays for temporary storage. Later the sheet is clipped into desired sizes and glued into plywood panels.



TYPE OF HOT PRESS USED IN MODERN PLYWOOD PLANT

claimed exemption on the ground of being indispensable employees. Sometimes they were confronted with rather elastic conceptions of this basis of exemption. There was, for instance, the experience of a certain Tennessee board. A country sawmill operator filed a petition for the exemption of a worker named Willie Hawkins who, he pleaded, was essential to the operation of his mill. "If Willie goes to the Army I'll have to shut down," he said emphatically. Investigation revealed that Willie did not work for the sawmill operator or, in fact, for anybody else. Sternly confronted with this damning fact, the sawmill man readily agreed. "Oh, no," he said, "Willie don't work for me. He don't work for nobody. He's a crapshooter. But, you see, before Willie moved into our town I never could keep a mill crew together. They would work a week, collect their wages and then take off a few days or a week to spend their money. Since Willie came to town, he gets them in a crap game every Saturday night and wins their money, so they have to come back to work Monday morning and I'm able to run full time. I'm getting out lumber for an Army camp, and Willie can do the Army more good by staying where he is than by going off to war."

The principal agency through which the lumber industry was able to function effectively in co-operating with the Government was the Lumber and Timber Products War Committee. Keeping any business going under the manifold restrictions and regulations of a state of war is a matter of great difficulty. This was especially true of the lumber business, since many of the individuals engaged in it were more experienced and adept at chopping down trees and sawing logs into lumber than in digesting and interpreting the involved terms in which Government orders and directives were phrased. Without the services of the War Committee, and its associated regional committees, the industry would never have been able to do what it did—would not, indeed, have known what was expected of it or how to go about it.

The committee was an outgrowth of the Lumber and Timber Products Defense Committee which was set up in August 1940 at the request of the Advisory Commission to the Council of National Defense. It was truly representative of the whole industry. All groups, regardless of association affiliation, were invited to participate in selecting its membership. After the entry of the United States into

active war, the committee changed its name and continued to function just as representatively.

The War Committee was instrumental in effecting a number of improvements in the relations of the Government with the industry and in increasing the efficiency with which the war effort was served. Largely through its suggestions a centralized program of buying lumber for governmental needs was established. It assisted in bringing about a lumber division in the War Production Board. Following its recommendations, beneficial changes were made in the Government's lumber specifications, expediting delivery and promoting economical utilization of available material. It helped lumber operators, large and small, solve the problem of obtaining necessary equipment and supplies. It kept the lumber and timber products industries' principal war problems before the various Government agencies, and pressed for their solution.

The War Committee represented thirty-three organizations and groups in the lumber and timber industries. As a matter of operating efficiency, it functioned through the National Lumber Manufacturers Association as its officially selected administrative agency. This association was well equipped for the task. It maintained its headquarters in Washington, and its offices and personnel were at the command of the committee. And an important detail, since the committee had no source of revenue, was that the association paid the expenses of the committee's activities.

During the early days of World War II, when the lumber industry was being mobilized for the war effort, a popular attractive slogan was "Wood Will Win the War." It would be an exaggerated claim to alter this slogan to say "Wood Won the War"; but the American lumber industry, looking back on the record it made during those wartime days, can have the satisfaction of knowing that its efforts did contribute very largely and very valuably to the winning of the war. Wood did not win the war—but without wood the war might not have been won.

Chapter XII

WOOD PRESERVATIVE TREATMENTS

THE art of treating wood with preservative chemicals to prevent its decay is by no means new. Various methods of wood preservation have been practiced for centuries. More than a hundred years ago, on the Continent of Europe and in England, activities demonstrated the feasibility of such treatment. The real commercial development of wood-treating plants in this country, however, is less than seventy years old. There had been a few experimental projects here, based largely on the European experience, and they had demonstrated the efficacy of chemicals properly injected. European practice had by then narrowed the preservative chemicals down to two: creosote and zinc chloride, and these two forms of treatment still account for more than 90 percent of the volume of wood preservation in this country.

Creosote belongs to that numerous family of valuable products produced by distilling coal tar. The first fractions collected in such distillation are the light oils; the final residue is pitch; the intermediate portion is that used for wood preservation. Various types of coal-tar creosote may vary in individual characteristics, but there are standard specifications in application, and all types must conform to them. Creosote is the most widely used of all the wood preservatives, its advantages being: high toxicity, which makes it deadly to wood-destroying organisms; its relative insolubility in water, combined with its low volatility, which prevents its leaching out or evaporating; its ease of application; the ease with which its depth of penetration can be determined; and its general availability and relatively low cost.

It is effective and suitable for all uses except those where its odor might be objectionable or where painting is desired. Aluminum paint can be used on creosoted wood, and is so used to a considerable extent on guardrails, bridge railings, roadside poles and other places where increased visibility is desired. Generally speaking, however, creosoted wood is not adaptable to being painted.

Zinc chloride is a water-soluble chemical, which for many years was the favorite treatment where creosoted wood was not adapted to

the conditions. Its advantages are relative cheapness, general availability, uniformity of quality, cleanliness, lack of odor, ease of shipment and handling, and lack of fire hazard. Its principal disadvantage is its tendency to leach out when exposed to moisture, and consequently it is best adapted to unexposed uses.

Within the past few years the zinc chloride treatment has been improved by the addition of sodium chromate; and since 1950 copper salts have been added, which should give somewhat better results.

There are other types of clean and odorless wood-preservative treatments employing proprietary brands of salts in water solutions, such as Chemonite and Tenalith-U (Wolman salts), which consists of certain percentages of sodium fluoride, chromate, arsenate and dinitrophenol. Of the total amount of wood treated in the United States each year, that treated with creosote ranks first by a wide margin.

Practically any kind of wood may be given a preservative treatment. In commercial practice, however, most of the treated wood is of the softwood species, principally Southern pine and Douglas fir.

The primary purpose is to protect the treated wood from decay. Decay is the result of the action of fungus growth in the pores of the wood. These fungi find their favorite food in certain substances in the wood cells, and as the spores germinate they destroy the cell walls. To germinate and live the spores require four things: air, moisture, food and the proper temperature. The art of wood preservation is based on the theory that the best way to prevent decay is to destroy the food supply, since it is difficult to control the other three factors.

The object being the destruction of the food within the cells upon which the decay fungus feeds, it follows that the preservative chemical must penetrate the wood cell sufficiently to effect it. The very great majority of all wood-preservative treatments today inject the chemical into the wood by impregnation under pressure, the amount of preservative and the depth of penetration being subject to control to suit the varying requirements of the treated product.

There are various types of pressure processes, but the general principle of all of them is the same. The plant consists of one or more steel treating retorts or cylinders. A cylinder is from 6 to 9 feet in diameter and 120 to 150 feet long, capable of withstanding a pressure up to 300 pounds to the square inch, and has a narrow-gauge

track running its entire length. Small cars loaded with the material to be treated are made up into trains the length of the cylinder, and these are pushed into the treating retort by a light locomotive or tractor. The door at the end is closed and hermetically sealed, and the preservative is then applied under steam pressure. If the wood to be treated is unseasoned, it is conditioned for treatment either by steaming and then pulling a vacuum or by boiling in creosote under a vacuum. After this, the hot preservative is admitted to the cylinder by opening a valve, and when the cylinder is completely filled with the preservative the pressure is applied by force pumps until the required amount has been absorbed by the wood. The excess preservative is then drained out, the doors opened and the treated wood removed.

There are two classes of pressure treatment: full-cell and empty-cell. The full-cell process fills the cells of the wood with as complete a saturation of the preservative as can be had; the empty-cell process seeks as deep a penetration as possible with a third or half smaller quantity of preservative. The effectiveness of the treatment is generally determined by the depth of the penetration; but there are some uses which require greater penetration than others.

At first it was the general practice to give all preserved material the full-cell treatment, and this was desirable and necessary in the case of such materials as piling used in salt water infested with marine borers, and in similarly severe conditions. It soon became apparent, however, that such complete treatment was not necessary where the conditions were less severe, and so the empty-cell process was evolved. Modern wood-preservation plants are equipped to obtain suitable penetration and retention of the stipulated amount of preservative. Also, the modern conception of treatment has broadened, and is now recognized as a means of protecting wood from termite and other insect attack as well as from decay.

One reason for the slow growth of wood preservation in this country in the old days was the supposedly inexhaustible nature of the forests. There seemed no particular reason for spending money to save the wood. The first cost of untreated wood was lower, and if it rotted away there was plenty more where that came from and it could be easily replaced. The use of treated wood finally got its start for an entirely different reason—as a labor-saving measure. The labor costs involved in frequent repairs and replacements became so bur-

densome that means of reducing this expense were sought. Then as labor costs, and timber costs, increased, the economies inherent in preserved wood became more apparent, and its use correspondingly increased.

The treatments were first used in the United States by the railroads for the piling, ties and timbers of bridge construction. These materials, subjected to unusually severe conditions promoting decay and deterioration, did not last long in the untreated condition. When pressure-treated with creosote, however, they built up enviable records of durability, and soon the railroads were using creosoted materials exclusively for such purposes.

They were the real pioneers in wood preservation. They used a lot of wood in bridge timbers, crossties and piling, and they sensed promptly that to lengthen its life would be a good thing. Their first experiments were of a stumbling and primitive sort. They soaked crossties and piling in common salt, for timbers used in salt mines were observed to last longer than those in other mines. One railroad in the South experimented with applying a mixture of tar and oil to the wood, and others tried out zinc chloride.

The wood-preservation industry in this country had its real beginning, however, in 1875 when the Louisville and Nashville Railroad built a creosote-pressure treating plant at Pascagoula, Mississippi —still, by the way, in operation. By 1880 there were three such plants in the South, and the industry was on its way. Today we have about 185 commercial pressure treating plants, operating approximately 400 treating cylinders, and the total output is around four billion feet a year.

Since its beginning as an adjunct to the railroad business, the use of preserved wood has spread to the construction and other fields, but the railroads still use over one-half of all the treated timber. It has been estimated that our roads save about $775,000 a day by using treated ties, and this does not seem an exaggeration in view of the great reduction in the rate of tie replacement.

Otherwise, one of the principal outlets for treated wood is in marine construction. Large quantities of creosoted wood are used in building and maintaining the docks and piers of the various ports, permitting a low-cost type of construction which has also the virtue of durability and long service.

Public utilities use treated poles, crossarms, etc., in quantities that have grown tremendously during the past twenty-five years.

Creosoted wood has figured importantly in road construction, as the various highway departments have come to realize that a creosoted wood bridge can be built for less than the cost of a so-called "permanent" type. A properly designed bridge built of treated wood has the same strength as one built of any other material; and, by virtue of the preservative, will last as long as the average highway bridge is required to last. Furthermore, if the road is changed, as happens so often, the bridge has a salvage value which is not possessed by any other sort of construction—its material can be used again elsewhere.

In factory and industrial building treated wood is being used more and more, and this is particularly true now that improved forms of construction have repopularized wood as a building material.

A weak link in the merchandising chain between the producer of treated wood and the ultimate consumer home-builder has been that he could not get small quantities through retail lumber yards. This condition has improved somewhat of late. Some sawmills have installed wood-treating plants and are able to supply their dealers with treated wood in mixed cars. But the average person still has some difficulty finding what he wants to buy if he decides to refloor his back porch with treated wood or wants creosoted sills in his new barn.

Someone has said that there is no way of knowing how long creosoted material will last. None of it has been in service long enough to show the extreme length of its life. There are numerous instances where it has been used, salvaged and reused, and still seems as good as new. A county highway department in Kansas (Barber County) in the early 1930's salvaged about 600 pieces of wooden piling from some abandoned railroad bridges. Most of them had been originally installed in 1916, though some in 1908. The county put the piling back into use in 1935, and upon recent inspection it was still giving excellent service and showed every indication of being good for another quarter-century in its new location. Examples of this kind might be cited in all parts of the country. The oldest and longest creosoted timber bridge in the world is the ten-mile span of the Southern Railway over Lake Pontchartrain. It was built in 1883 and, containing a

large percentage of the original material, is in good condition after 68 years' service.

The use of creosoted wood piling has made possible a vast amount of construction on low, soft or filled locations, where difficulty is encountered in establishing a solid foundation.

Piling is the collective name for wood piles, and a pile is nothing but a wooden pole, generally creosoted. They are driven into the ground to afford foundations where the bearing power of the soil is not otherwise sufficient, and they are used also in building bridges and trestles. Piles are generally inserted by a steam-powered driver, which forces them into the ground by repeated blows, just as a stake is driven in the ground with a hand hammer.

Piling is used not only in such construction as docks and piers, which are built directly on the seacoast or navigable waters, but also in many commercial jobs where the footings are insecure. In such large cities as New Orleans, for instance, practically all the larger buildings have their foundations resting on top of long wood piles driven into the soft ground. Many buildings in metropolitan New York are so based. The Queens Poultry Market, completed in 1942, and the Brooklyn Terminal Market, erected in 1943, are recent examples of New York structures built on piling. The latter group of buildings, covering twenty acres, is located on a filled-in sand pit, and about 2,000 piles, from 30 to 55 feet long, were driven in to make a firm footing. Piles of Southern pine or Douglas fir, treated with 12 pounds of creosote per cubic foot, are considered as permanent foundations for buildings or other construction work, when cut off above ground water, buried in the ground and capped with masonry. The use of foundation piles for such purposes has been approved and is in all the leading building codes of the country today; and the use of creosoted piles for foundation purposes has increased considerably over the last ten years or more.

Creosoted piling and other creosoted wood are employed for the revetments along the Mississippi River, where it is necessary to protect the banks and the levees from the eroding power of the river current. In this sort of work, and also in bulkheads and the like, recourse is had to what is known as "sheet piling"—solid sheets of wood made up of three thicknesses of thick planks, nailed or bolted together, and perhaps also locked together by a form of tongue and groove.

Though pressure impregnation in closed cylinders is the most successful method known for the large-scale treatment of wood with preservatives, there has been considerable progress in the so-called nonpressure processes. Extensive experiments in the cold-soaking treatment of Southern pine sapwood with low viscosity oil solutions of pentachlorophenol indicate that when efficient penetration is obtainable, this method of treatment affords protection in material which is not to be subjected to extreme hazards of decay.

A few years ago the National Door Manufacturers Association realized that extended use of wooden window sash was hampered by the fact that, when exposed to unfavorable weather conditions, wood has a tendency to swell and shrink with successive changes in the weather; and that most varieties of untreated wood will decay when exposed. There are, of course, innumerable examples of the longevity of wood—notably the famous Fairbanks house in Dedham, Massachusetts, which was built three hundred years ago and is still in excellent condition, though it has never even been painted. The general impression among home-builders, however, has been that wooden windows are inferior to some of their highly publicized substitutes. To counteract this, and to give the quality of extra-durability to exterior woodwork, the millwork manufacturers bent their energies. The result of their study was the evolution of a statement of minimum standards for the treatment of window sash with toxic preservatives and water-repellent reagents. Manufacturers who treat their wood in accordance with these minimum standards are licensed by the association to use their official "Seal of Approval" on all such woodwork as an assurance to architects, contractors and builders that it will be found durable and dependable.

The fireproofing of wood has interested the world's construction experts for centuries. The fact that wood burns has been recognized as one of its greatest shortcomings as a construction material; and though the fire hazard has been frequently exaggerated by purveyors of substitute building materials, the development of a cheap, convenient and effective fireproofing treatment has been the goal of chemists for a long time. Fire-retardant paints were known to the ancient Romans, and have been used with more or less success ever since. Ordinary white lead paint, heavily impregnated with borax, makes a fairly satisfactory paint of this kind for interiors. What the lumber trade has needed and wanted, however, is some chemical

which could be used in any circumstances and would have the combined virtues of cheapness, effectiveness and availability, such as is possessed by the wood-preservative treatments.

Wood, pressure-treated with fire-resistant chemicals, has been on the market for over fifty years. A plant for its manufacture was established in New York in 1895. Wood treated there has been used by the United States Navy, and the Navy's experience prompted the city of New York in 1899 to amend its building code to require the use of the so-called "fireproofed" wood in buildings more than twelve stories high. As a result of this law, other treating plants were set up in the New York area, and they supplied millions of feet of "fireproofed" lumber for New York buildings, as well as for ships and other purposes.

The principal drawback to this early treatment of wood to reduce its combustibility was that, due largely to the unnecessarily rigorous specifications, it was fairly costly—from $75 to $100 per thousand feet. This naturally limited its adoption, and the search went on for a low-cost process that would be effective. This search has now approached a successful conclusion near enough to make fire-retardant wood available on a commercial basis. It was used extensively in the vast wartime construction program. The fireproofed wood being furnished today does not cost more than a good creosote treatment.

When wood burns its combustion is the result of a simple chemical reaction. The initial heat causes the wood to give off water vapor, following which a decomposition ensues and volatile gases are developed which ignite into flames. As the heating process continues, the burning of the nonvolatile wood substance produces carbon monoxide gas, the combustion of which continues until the wood is entirely consumed and only the ash is left.

There are two possible approaches to the problem of "fireproofing" wood. It may be covered with some form of superficial surface coating, such as paint, which prevents the access of air to the wood and so retards combustion. Or it may be treated with some form of chemical combination, impregnated into the cells of the wood, to retard the spread of the flame by controlling the formation of the combustible gases.

The various forms of fire-retardant paints or other surface applications vary in effectiveness, depending on the character of the material and the method of application. Such treatments, properly prepared

and properly applied, are effective in checking the spread of flame in small fires, but are limited in value in severe fire exposure.

The impregnation method gives the best promise of making wood fireproof or greatly fire-retardant. In the past few years decided progress has been accomplished, and there is now a prospect of the promulgation by the Bureau of Standards of its first standards for fireproofed woods. More than a hundred and thirty chemical formulas have been studied and the new standards, when published, will represent a combination of technical effectiveness and commercial workability.

It is a demonstrated fact that certain chemicals are highly effective fire retardants if injected under pressure to sufficiently high retentions. Formulas employing such chemicals as ammonium phosphate, ammonium sulfate, boric acid and borax, have a record of performance in preventing flame. Moreover, borax and boric acid melt at fire temperatures and form a viscous protective coat which insulates the wood fibers from the air supply necessary to support combustion. Ammonium phosphate and boric acid have the important quality of preventing afterglow or smoldering. These chemicals have been used for years, and long trial attests their worth.

When fire comes in contact with treated wood, combustion is prevented by four agencies: the water of crystallization given off by the chemicals; the formation of a protective armor, a relatively inert coating of an incombustible, clinkerlike charcoal which protects the wood underneath it from the effect of the flame, and prevents the formation of inflammable gases which would feed the flame; the formation of a glazed coating over the surface of the wood; and the evolution of a smothering blanket of inert gas. Long experience has shown that charcoal itself is one of the most effective forms of protection from fire, and wood timbers of large cross section, even when untreated, are highly fire-resistant because of this property. The introduction of the fire-retardant chemicals into the wood cells helps build up the armoring char layer quickly.

The fireproofing treatment, as in wood preservation, is carried out by a pressure process in closed cylinders, assuring a deep and uniform penetration and a high absorption of chemical, also full control at all stages of the schedule. The process of impregnation is simple. The material to be treated is loaded onto small cars and moved into the cylinders. After preconditioning with steam, a vacuum is drawn,

the solution of chemicals is forced into the retort and the pressure raised to the desired point. The pressure is held until the wanted penetration is secured—from six to twenty-four hours being required —and at length the retort is drained and the material removed.

The war and wartime construction greatly increased interest in the use of fire-retardant wood. To prevent losses and to avoid interruptions in the war program the Government had to be particularly careful to reduce the fire hazard as much as possible in all of its structures; and it used many millions of feet of fire-retardant lumber for its building projects—the big blimp hangars, other aircraft buildings, ordnance plants, ships, wharves, etc.

The possibilities of fire-retardant wood in construction seem great. Its use will localize any fire originating in inflammable contents and prevent destructive spread. Its widespread adoption may occasion a revolutionary change in some phases of construction.

Chapter XIII

TIMBER ENGINEERING

DURING recent years one of the most outstanding developments in the construction world has been the rebirth of wood as an engineering material.

There was a time when wood was the natural and generally accepted material for the framing of practically all our buildings, the exterior of many and the roofing of most. Then came the introduction of other materials, notably the era of steel-frame construction, and wood began to fade into the background. It was still used in housebuilding and in small structures; but the system of building with heavy timbers, called "mill construction," declined rapidly in popularity. A new generation of engineers had been graduated from the technical schools, educated in the exact science of steel construction and taught little about wood as an engineering material. When this new crop of construction engineers thought of wood at all they thought of it as a secondary and outmoded material and gave it little or no consideration for important structural installations. For this the lumbermen themselves were partially to blame. They took no active steps to hold their position in the heavy construction field while the steel and concrete interests were ably and aggressively merchandising their products. The decline of wood was a natural and inevitable consequence—but it was due to no shortcoming in the material itself.

During the past twenty years, however, wood construction has been steadily regaining its lost ground. This has been the result of two developments: the introduction of the Teco timber-connector system of construction; and, more recently, the rapid development of glued laminated construction. The development of a fabricating branch of the industry, comparable to the steel fabricators, has simplified the use of this versatile material. There are today some sixty firms, in all sections of the country, which can deliver to contractors at the job sites prefabricated timber roof trusses and framing all ready to erect—and often the fabricators do the erecting themselves. In addition, hundreds of contractors are now experienced in

this system of construction, and many do their own fabricating at the job site. It is easy and convenient to specify and secure prompt delivery of timber trusses.

Modern wood construction is now recognized as having a strength, economy, flexibility and availability that make it comparable to other structural materials. It is no longer regarded as outmoded. Stimulated by the wartime program of extensive building all over the country, wood construction is being used more widely today than for many years. Wood is definitely back on the map as an engineering material of established and recognized excellence.

The development of the Teco timber-connector system of construction brought about a revolutionary change in the method of using wood in building. Teco connectors are simple in appearance, simple in principle and simple in application; but their utility value is out of all proportion to their simplicity. They are nothing more than steel rings or malleable iron castings, from two to six inches in diameter, but they have established a new application of engineering principles for the design of timber structures. The split ring, the most popular of the Teco devices, is installed in precut circular grooves in adjacent faces of overlapping structural members to provide a larger bearing area than that attained by previous methods of joining timbers, such as bolting. The connector spreads the load at the joint more equally over the cross section of the wood and so utilizes more fully the structural strength of the timber.

A construction engineer describes how it works: Timber-connector split rings are split across at one point, the split being in the form of a tongue and slot. The purpose of the tongue-and-slot split is to provide bearing on the wood inside as well as outside the ring. The split ring operates as follows: To insert a timber connector between two pieces of timber to form a joint, each facing piece is first grooved to one-half the depth of the ring. The ring is inserted in the groove of one of the two timber members to be joined, and the other member is then placed so that when the two members are joined, face to face, the ring is wholly imbedded within them. The circular grooves, each one-half the depth of the ring, are cut with a special grooving tool to a dimension slightly larger than the unexpanded circumference of the ring which is to be inserted. When the ring is forced into the groove the tongue-and-slot split is forced apart slightly; and when the ring is thus imbedded in the timber,

with its split slightly parted, it can expand and contract with the wood and thus form at all times a tight and rigid connection. The connecting through bolt is relieved of stress by the imbedded connector ring and serves principally to hold the two timber members together, face to face. In the past weakness at the bolted connections has retarded the use of timber as heavy structural material. Pound for pound, timber has the strength of steel in bending or tension, but its bolted joints were its Achilles' heel. The timber connector spreads the load on a timber joint over practically the entire cross section of the wood and thus brings into play the full structural strength of the lumber. Other types of connectors, equipped with teeth, are forced into the wood, no pregrooving being necessary.

Timber connectors originated in Norway and Germany and have been used in European construction for years. Back in the 1920s samples of these connectors were brought to this country and tested by the United States Forest Products Laboratory. But lumbermen to whom they were exhibited reacted in emotions varying from apathy to derision. One man who took them seriously was Dr. Wilson Compton, then manager of the National Lumber Manufacturers Association. He saw in them the means of greatly increasing the use of wood and improving lumber construction. He kept samples of them on his desk, and he talked about their possibilities to every lumberman who came to his office. One visitor's comment was typical: "That's a mighty pretty little gadget, and they may use a lot of them in Europe, but it will never be used in this country for anything more than you are using it for now—a paperweight."

But Dr. Compton had determination as well as vision. He was confident that the introduction of connectors would broaden lumber's construction possibilities. In 1923 the Timber Engineering Company, an affiliate of the National Lumber Manufacturers Association, was incorporated for the purpose of introducing the connector system of construction in the United States. The declared purpose of the company was to improve and extend the use of lumber and timber products, to provide a source of information and technical services on all types to timber construction and commercial uses for wood.

The Timber Engineering Company is a unique sort of business enterprise—a private corporation empowered to engage in trade for the benefit of a whole industry. The company's stock is owned by the National Lumber Manufacturers Association. The company oper-

ates for profit. It renders engineering and technical services. But when it makes any money the profits do not go to any individual stockholders. They are plowed back into educational engineering and research activities. No individual ever has made or ever will make a dollar's profit out of its operation. But the lumber industry as a whole has already profited greatly—and so have the construction industry and the public.

In undertaking to promote the sale and use of the connectors when they were first introduced, the Timber Engineering Company had a problem. It had not merely the task of selling a tangible though unfamiliar building accessory. Its real job was to sell a system of construction that features the advantages of building any kind of structure in wood—and this involved convincing professional designers. The progress has been gratifying. Since 1933 more than 8.5 billion feet of lumber have gone into structures whose designers have encouraged its use because of Teco connectors. The lumbermen have sold more lumber, the company has sold connectors, the contractors who have used them are satisfied customers, and the resulting buildings have been stronger structures at less cost.

One thing that helped to extend and popularize the connector system was the engineering consultation service offered by the Timber Engineering Company. This service is supplemented by a distribution of literature explaining and illustrating modern practices in timber design. Practicing engineers and architects are currently supplied with up-to-date technical data to guide them properly in designing timber structures. For years now the company has supplied technical data annually to students of architecture and engineering in the United States and Canada. The regional associations of lumber manufacturers and the fabricators have also played an important part in this educational work.

The inception of the tremendous defense building program of World War II gave the Teco promotion a veritable shot in the arm. It was clear that to build all the military camps, depots, warehouses and munitions plants, and do it promptly, would tax the facilities of the country; clear too that steel and other metals were going to be scarce. The Government's engineers showed a laudable willingness to entertain new ideas and adopt methods and practices that would speed the program and reduce the use of steel, sorely needed in the direct production of munitions and warships. These engineers

investigated the Teco system. It had been time-tested in more than twenty-five thousand structures, so they were able to check on its record of actual performance. And their investigation sold them on the idea.

The effect was immediately felt. Within a few months the Teco system was established as an accepted and practical factor in the construction world. More than four hundred thousand tons of steel was saved for essential war production in one year by using the Teco system of construction.

The Army was the first branch of the Government to see and seize the opportunity, but all the war agencies made use of the new system. A monumental example was provided by the Navy's building of an extensive system of blimp hangars. These gigantic structures are of proportions previously thought impossible with wood construction—1,058 feet long and 297 feet wide in over-all dimensions. The fabricated timber arches rise 153 feet from the floor, clear-spanning an unobstructed area 237 feet wide. The arches are 19 feet deep at the base and 13½ feet at the crown. The timbers composing them are assembled and fastened together with 4-inch Teco split rings and shear plates with ¾-inch bolts. They are from 3 by 12 inches and 4 by 8 inches at the crown of the arch to 4 by 14 inches and 6 by 14 inches at the base. The arches are spaced on 20-foot centers and spring from reinforced concrete flying buttresses. Purlins, 3 by 14 inches, rest on the top chord and carry 3-by-12-inch rafters. The roof is sheathed with 2-inch lumber. Each hangar required about three million feet of lumber in its construction.

Such buildings with so much clear space inside floor, walls and ceilings—a clear volume of 22 million cubic feet in one structure—set a new record in this type, or perhaps any type, of construction. They are recognized in the engineering world as the greatest structures ever built of wood at any time, at any place in the world.

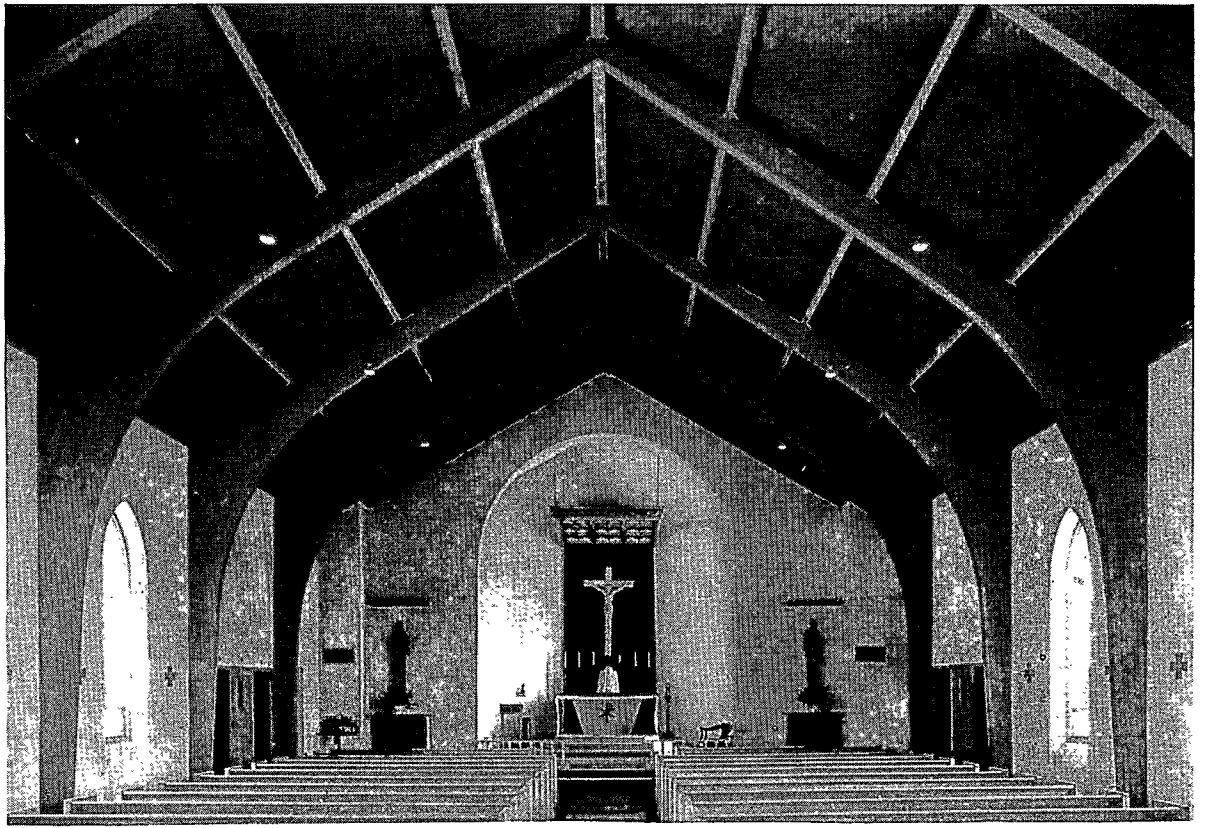
The layman's knowledge of wood seems often confined to the notion that wood burns and some other materials do not—a fact which the purveyors of substitute materials have not failed to emphasize and capitalize. Study of the subject, however, shows that factors other than combustibility are equally important.

The fire hazard in structures such as hangars, shops, garages and warehouses generally does not arise from the nature of the structural

material itself so much as from the contents of the building or from external conditions to which it is exposed. It is the nature of the contents that determines the rate of spread once a fire is started. If the contents are highly inflammable, fire will spread through an entire building within a few minutes, with high temperatures built up rapidly. Experiments conducted by the American Society for Testing Materials show a temperature of 1100 degrees reached within six minutes. At that temperature certain structural metals have less than one-half of their normal tensile strength. At 1700 degrees they will not support the dead weight of a structure. At 2000 to 2500 degrees—temperatures reached where there are highly combustible contents—unprotected metal will collapse so quickly as to preclude the possibility of fighting the fire properly. On the other hand, wood, though it will burn, loses its strength principally in proportion to the degree of charring. Tests show that usually wood chars and burns at the rate of about one inch in depth in thirty-three minutes and that the actual failure time for wood construction is much longer than is popularly supposed.

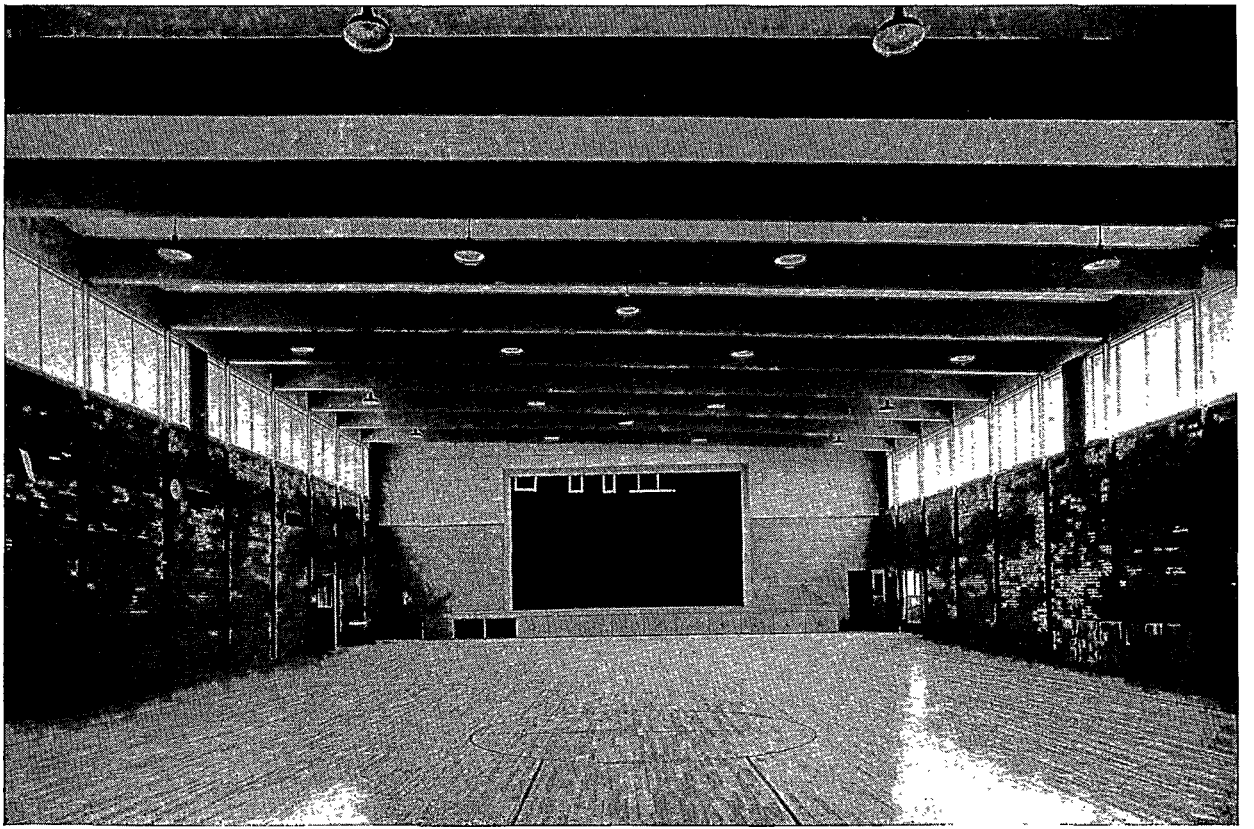
The fire-safety value of a lumber-built airplane hangar, equipped with sprinklers, was shown in an impressive demonstration by the United States Bureau of Standards. In a series of seventeen fire tests forty Army airplanes were consumed along with hundreds of gallons of gasoline and oil. In the final test four airplanes, with tanks filled with 360 gallons of gasoline and 40 gallons of oil, were placed in the hangar. Fifteen gallons of gasoline were then spilled on the floor and ignited. At the end of these tests the hangar was still in excellent condition, with only two lightly burned places on the wood-sheathed walls and roof.

The Teco method of timber engineering has made some other record-breaking contributions in the construction field. It made possible the erection during 1943 of the world's largest factory ever built of wood—the Douglas Aircraft Corporation's plant at Chicago, put up under the supervision of the United States Army Engineers. This mammoth plant required thirty million board feet of lumber; and the use of that lumber saved approximately twenty thousand tons of steel. A most interesting structural distinction was the use of wooden trusses 150 feet long, supported by massive wooden columns running as big as eighteen by thirty-five inches in cross section and fifty-four feet long. Big sticks of this size can be had in solid



Courtesy Timber Structures, Inc.

GLUED LAMINATED ARCHES IN A MINNESOTA CHURCH



Courtesy Timber Structures, Inc.

GLUED LAMINATED BEAMS IN A GYMNASIUM IN OREGON

ought not to cut down small trees; it was quite another matter, and far more convincing and conducive to a change in his ways, to cut down trees of different sizes, keep cost and time studies on them and prove that below a certain diameter limit the small tree does not pay its way through the sawmill. The monetary advantages of selective logging and sustained yield were first demonstrated by these studies, as well as the benefits to be derived from the adoption of new methods, new devices and new equipment as they became available. Such organizations as the Pacific Logging Congress have been of incalculable benefit to the loggers of the West. Similar educational work was done for years at the regional meetings held by the conservation department of the Southern Pine Association and is now being done by the Appalachian Hardwood Manufacturers.

It is in logging that the great technological change in lumbering has occurred during the past thirty years. Beginning about 1920, and growing with particular intensity since 1930, there has been an ever greater use of tractors and trucks. The introduction of the crawler-type tractor wrought what amounted to a revolution. It increased efficiency and lowered operating costs, and, above all, made possible a change-over to selective logging and sustained yield which has altered the entire complexion of the industry. The crawler-type tractor by itself is a valuable substitute for animal power in the primary function of moving logs from one place to another. Since its introduction, various auxiliary devices have become available in the way of drum-hoists, loading booms, high-wheel arches, etc., which have given to modern logging a combination of power, speed and flexibility impossible with old-style equipment.

The motor truck also has had much to do with the change. Not only has it proved valuable—indeed almost indispensable—in logging operations, but it has also made a special place for itself in the hauling of logs and lumber over the public roads. Many of the smaller mills which depend on bought logs for their life have greatly extended their scope because the motor truck gave them a wider field to draw from. Also, hauling lumber by motor trucks from small portable mills to centralized concentration yards afforded the modern means of effectively merchandising the output of small mills.

Trucks and small tractors have replaced animal power to a notable extent, especially at the larger mills, in hauling loaded buggies from the green chain to the yard. Evidence of the greater mechanization

of the industry is to be seen too on many yards which use automatic stackers to raise the lumber from the ground to the top of the pile. Some of the very largest mills can afford overhead trolley systems for handling unit packages or piles.

Especially helpful is a curious-looking carrier or straddle-type truck—an ingenious device designed to carry the load under the chassis instead of above. At the green chain the lumber is stacked in compact units, on two wooden crosspieces or "bunks." These stacks, of the proper dimensions, are easily straddled by the carrier for instant pick-up and transport to any point on the operation. The carrier is equipped with mechanical grapples and a hoist to take hold of the ends of the bunks and raise the unit off the ground sufficiently to move it wherever desired.

The first practical straddle-truck was designed and built by Harry B. Ross in 1914. After a thorough tryout, it was placed in active service at the Crossett-Western Lumber Company plant at Wauna, Oregon, in May 1915. Since then the mechanical handling of lumber has spread through the country, and the equipment is now made by two or three different manufacturers.

The lift truck, which nuzzles up to a stack of lumber and lifts it by its nose, has proved a perfect companion to the straddle-type carrier. Familiar in other lines of business, it is a comparative newcomer here. The lift truck for lumber is larger than anything else of its kind and is equipped with pneumatic tires and other features to meet the special requirements. During recent years it has proved its effectiveness in piling green lumber for air-drying or kiln-drying, handling of dry lumber, indoors or out, unit package storage, back piling or truck loading, etc.

From the time men began to manufacture logs into lumber they have studied the problem of seasoning—but the drying of wood remains a complex process and there are still phases of it not completely understood. When a piece of freshly cut lumber comes from the sawmill it is "green." This has no reference to its color. It may be white pine, red oak, brown ash, black gum or yellow pine; but if it is freshly cut and unseasoned it is green in the lumberman's parlance. In green condition lumber is more or less saturated with moisture in two different forms: "free" water, which is that in the cell cavities and other spaces; and "bound" water, which is that in the fiber or

cell walls. Before the lumber can be used to best advantage this moisture must be removed. Getting out the free water causes no change in the dimensions of the wood; but when the bound water is taken from the cell walls, there is always danger of damage to the wood fibers from shrinkage. It is this that makes lumber seasoning difficult.

In their efforts to improve the quality of their delivered product, manufacturers long ago recognized that it was to the great advantage of everybody concerned to be sure the lumber was properly seasoned before put to use. In a green or half-dry state it cannot give satisfactory use, but the average user is not able to distinguish between green and dry wood. If he happens to employ improperly seasoned lumber he soon knows it with a jolt and he jumps to the easy conclusion that wood is essentially an inferior material or that "you can't get good lumber any more." So, from self-interest if for no other reason, the discerning manufacturer is keenly interested to see to it that the lumber he ships is properly seasoned before it goes on the job.

More attention to seasoning has led to more use of dry kilns during the past thirty years. In no branch of the lumber business have greater scientific advances been made—improvement in their manufacture and design accompanying improvement in the skill with which kilns are operated. This is increasingly important under modern conditions, as moisture-content provisions are now included in most softwood grading rules, and more buyers are now specifying lumber of a specific moisture content instead of using the archaic terms "bone dry" and "thoroughly dry" and other such familiar but meaningless phrases.

An ingenious modern device which helps the lumber buyer make sure that he gets what he buys is a "moisture meter." It is hard to describe one without employing the obscure technical jargon of electricity. In a broad way it may be said that there are three electrical properties of wood that may be employed to ascertain its moisture content: direct resistance, capacity as a dielectric, and inductance or power absorption. In practical use the moisture meter, of whatever type, has electrodes—generally sharp-pointed pins—which are stuck into the wood and which cause the meter to indicate its moisture content. Manufacturers of established reputation make the meters. Some varieties are better than others. In general they have worked well.

As aids in the seasoning of lumber, especially those species and

sizes difficult to season by ordinary means, the lumbermen have employed various types of treatment with chemicals. One of the earliest was the application of common salt to green wood. It has been known and followed in various parts of the world for years, without specific knowledge of the exact scientific reason why it was effective. Experience showed that lumber of large dimensions and of species ordinarily hard to dry without unsightly cracks appearing in the ends of the wood could be coated with salt and dried without any such "checking"—as the cracks are called—and without the collapse of the interior wood fibers, known as "honeycombing."

As early as the fifteenth century manufacturers of buckets soaked their green oak staves in brine to prevent warping and cracking as the wood dried. Because it was observed that timbers used in the ancient salt mines of Galicia did not split on drying, salt-seasoning mine timbers was adopted in Central Europe more than a hundred years ago. The Moravian farmers seasoned their green oak in manure piles with notable satisfaction. Early American scientists impregnated lumber experimentally with sugar and molasses. Such things led to a series of tests of numerous forms of chemical treatment of wood by the Forest Products Laboratory and others, notably the West Coast Lumbermen's Association.

These tests demonstrated that salt-seasoning, especially as a pretreatment before kiln-drying, is highly effective for some species under certain conditions. Douglas fir timbers, six by twelve inches in cross section, were dried from the green condition to 15 percent moisture content in thirty-four days. Thick boards of Southern swamp oak, an especially refractory species, which under the best conditions required two hundred and twenty-five days to dry in the unsalted condition, were dried to 15 percent in thirty-six days. It is not entirely without its risks and uncertainties, however. For one thing, it does not appear adapted to the treatment of lumber which is to be painted or stained. Salt sometimes displays a tendency to "effloresce," or work its way out of the pores into which it has soaked; also, during periods of high humidity, wood so treated becomes damp.

The tests disclosed the extremely interesting fact that urea (the active agent in the Moravian farmers' system of seasoning) is one of the most effective chemicals for this purpose. Its cost was at first prohibitive, but manufacturing firms within the past few years have

succeeded in producing it at a figure that makes it available to industry.

Crystal urea is a white, crystalline solid resembling granulated sugar, and is highly soluble in water. It may be applied to the surface of the green wood as a solution in water or sprinkled on in crystalline form. The method depends on the species of wood, its dimensions, green-moisture content and other factors.

In the dry-spread system the crystals are spread on one face of the freshly cut green lumber, and put on heaviest at the ends of the boards. After the urea is applied, if the lumber is not to be immediately kiln-dried, it is piled in bulk—without stacking sticks—for about one day per inch of thickness before stacking in the usual manner for drying. This permits the urea to be absorbed into the wood.

The preferred method of treating green lumber is now the dipping method, using a 50-percent solution of urea containing about 2 to 3 percent of cornstarch and about ¼ percent of borax. The lumber is dipped in the solution just long enough to wet the surface completely and then piled on stacking sticks for air or kiln-drying. Dipped lumber is not bulk-piled, as is the desired procedure when urea is applied by dry spreading.

To prevent checking in the ends of logs or heavy timbers, urea may be made up into a paste with starch and plastered onto the ends.

In nontechnical English, the effect of the urea treatment is to prevent shrinking of the surface of the lumber while the inside cells are drying. It obviates "checking" and reduces warping to a minimum. It works particularly well with such items as thick oak and thick cypress, which are difficult to dry by ordinary means; but it is useful also in decreasing the drying time—and producing an improved product—in other species.

When scientific research revealed methods of chemical treatment which prevent staining of the sapwood of lumber it was a great boon. This stain, commonly called "blue stain," is caused by a minute fungus growth within the cells of the sapwood. It shows through the thin cell walls and gives the wood a bluish cast. The sapwood of practically all species is susceptible to this stain to a greater or less extent, but it is most prevalent in such softwoods as pine and in some of the hardwoods, such as gum. It does not affect the quality or

durability of the wood in any way, but is objectionable in appearance and renders the stained wood impracticable for any purpose where it is exposed in its natural finish. Sap-stained lumber is not acceptable to buyers and always had to be sold at a lower price. No wonder manufacturers years ago sought a way to stop the fungus that causes the discoloration.

As far back as forty years ago they were dipping their freshly cut lumber in solutions of bicarbonate of soda, which was moderately good. It left much to be desired, however, especially in hardwoods and particularly as to uniform effectiveness. So in 1928 the Forest Service, in co-operation with some interested lumbermen and chemical manufacturers, undertook an exhaustive study of a large number of new chemical compounds as sap-stain preventives.

The published scientific reports of these tests stated that penetration of the sapwood by the *Ceratostomella pilifera*, at optimum temperatures and moisture conditions, was reduced to a minimum by dipping the green lumber into solutions of such chemicals as sodium pentachlorophenolate, sodium tetrachlorophenolate and ethyl mercuric chloride or ethyl mercuric phosphate—in other words, the blue-stain fungus could be killed by them. Fortunately for the lumbermen these effective chemicals with the jawbreaking names were soon on the market under such trade names as Lignasan, Dowicide, Permatox, Melsan, Vancide and Santobrite, and they are now widely used throughout the lumber industry, especially in the South where climatic conditions are favorable to the growth of the stain fungus. Practically all the larger mills cutting susceptible stock are now equipped with dipping vats through which the green lumber may be carried on conveyer chains, and many of the smaller mills also have them.

One of the chemicals tested was borax, and it was found to be good on gum but apparently not so good on pine. Later experiments in another field, however, revealed that it is highly efficient for preventing attacks on certain hardwoods by the lyctus beetle. This is a small, innocent-appearing insect which has a voracious appetite for some kinds of wood if it can find them in dark, damp places—as, for instance, in the hold of a ship. Exporters of American lumber have had trouble occasionally with shipments which left our shores sound and bright and reached their destination full of tiny holes bored in the surface by the hungry lyctus. Dipping the lumber in borax, it has

been discovered, discourages the beetle's fondness for this sort of food, and postwar shippers in the export trade may expect to be freed from trouble. The chlorinated phenols, it should be added, also work to stave off lyctus attack and to kill infestations already started.

Truly startling has been the great progress made in the development of new and better types of glue and improved methods for their application to wood. They are, generally speaking, of three types: phenolic-resin, urea-resin and casein. The phenol-resin glues are used with a hot press to make glued joints that are proof against heat, boiling water or mold. For joints proof against cold water and mold, a cold-setting urea-resin glue is used. Casein glue is employed for other types of joints which are highly water-resistant, non-crazing and heatproof. Each type has its peculiar place where it works best. The newly devised wood-glue craftsmanship offers a wide field. It is based on the remarkably penetrating and holding qualities of the adhesives: two pieces of wood fastened together with them become structurally one piece of wood*—and this has promoted the wonderful developments in plywood and in the use of laminated beams and arches.

An outstanding accomplishment in this connection is the making of long and wide boards out of short and narrow ones. It is being done, for instance, on a large-scale commercial basis at the Clearwater, Idaho, plant of the Potlach Forests, Incorporated, where the results have been such as to encourage great hopes for future development in this field.

The production begins with the selection of narrow boards which are to be glued up. They are put through a ripsaw which produces a perfectly straight edge on both sides. Then they go through the machine that applies the synthetic resin glue to one edge of each board. The belt conveyer takes the prepared boards to the gluing machine on which they are laid up into panels of the desired size, and these panels are then inserted in the conventional hot-plate press. The press applies pressure from the top, to hold the panel flat, and a mechanically operated screw clamps the boards together from the side with a pressure of four hundred pounds. Under a temperature of about 320 degrees the glue is set in about two minutes. A board emerges 52 inches wide and 16 feet long—or of whatever desired dimension—

* See the discussion on page 247 and following.

which has all the properties of a Nature-made board of the same size; its glue joints are practically invisible and stronger than the wood itself.

In dressing or planing lumber there has been noteworthy progress. As it comes from the sawmill lumber is rough, but for most end uses it must be dressed to a smooth surface. Practically all the softwood lumber is delivered to the buyer in dressed form, and an increasing proportion of the hardwoods. The planing mill, therefore, has become one of the most important parts of a sawmill operation, and the talent of the manufacturers of woodworking machinery has been devoted to making planers that will produce high-quality lumber and more of it.

Feed tables carrying the rough lumber into the machines have been so improved as to step up the speed of planers and matchers tremendously. Thirty years ago the speediest planers and matchers would not handle much more than 200 to 250 lineal feet of stock per minute; today speeds of 500 feet are not uncommon, and some machines run at an even higher rate. This gait is not achieved at any sacrifice of quality; on the contrary, even better lumber is turned out than ever before.

An advanced planing-mill practice that has been growing in popularity is the end-matching of material for sheathing, siding, flooring and ceiling. The traditional practice of carpenters has always been to saw off to the proper length to make the joining ends meet on studs where they could be nailed. By putting a tongue-and-groove joint on the ends of such pieces as well as on the edges, strong end-joints may be made between studs, without nails and without the waste incident to cutting pieces off to the proper lengths to join on studs. The use of end-matched lumber conserves material and saves time, and should gain in favor.

A new wrinkle in improving quality and usability is the production of "plastic-improved" lumber now established on the Pacific Coast to such an extent that it is recognized in the official grading rules there. Since the beginning of grading practices, lumber has been classified on the basis of its defects—the more defects the lower the grade. A few years ago some genius in the employ of the Stimson Lumber Company, of Forest Grove, Oregon, had the happy thought that since these so-called "defects" are objectionable principally from

the standpoint of appearance, the objection might be obviated by replacing the imperfections with plastic wood—a sort of face-lifting operation applied to lumber. Accordingly routing machines were devised which would quickly and competently dig out all the knots, wormholes or pitch pockets, blow the sawdust out of them with compressed air, and fill the holes with plastic wood. After it has dried for twenty-four hours the plastic-improved board is ready for use—and customers have testified that it meets the same use requirements as a defect-free board. It can be planed, sawed, painted or varnished; it resists water, grease and rot; it holds nails and screws. It is possible to give about 16,000 feet of lumber per day the face-lifting process, and the cost is less than the increase in value. The plastic wood used for the filling of the holes is made by the company from wood flour and plasticizing vehicles. The formula was arrived at after extensive tests to determine hardness, resistance to abrasion, and strength.

Another ultramodern device is the "Skoog" patching machine, which automatically and at a single operation cuts a knot or other defect out of a sheet of veneer and fills the hole with a perfectly fitting piece of solid wood. The Skoog patcher is delightfully simple but most ingenious. At one stroke of its plunger, and in two seconds' time, it feeds a square piece of clear wood into position over the defect, cuts the defect out of the sheet and cuts from the patching blank a round piece exactly the same size as the hole, pushes out the defective plug containing the knot, and fits the patch in. Result: a clear piece of material which has no visible defects.

Technologically speaking, the American lumber industry has come a long way since Captain John Smith's sawyers laboriously hacked out the first clapboards at Jamestown in 1608, so long a way that the manufacture approaches the status of an exact science. The machinery with which the logging operations are conducted is better than the loggers of past generations would have thought possible. The sawmills and planing mills and modern practices contribute to the skillful production of well-made, well-seasoned lumber. With the proper preservative treatments it may be made practically rotproof and fireproof. The lumber buyers of today—and tomorrow—can get a better product than was ever before obtainable.

Chapter XV

RESEARCH—AND THE FUTURE

SHORTLY after our entry into World War II a mild flurry was set off in lumber circles by several magazine articles and a book called *Nazis in the Woodpile,* written by Dr. Egon Glesinger, a refugee from Austria. He painted an impressive picture of all the new German industries founded on forest products. These he described as Hitler's most important secret weapon.

Goering's whole Four Year Plan, according to this author, was based on the creation of a network of ersatz industries using wood as their raw material, which gave Germany an ever-renewable supply of things essential to national existence and removed the fear of industrial strangulation by blockade. Wood-gas and charcoal generators, we were told, provided the fuel for German automobiles, trucks and farm implements for civilians. Alcohol and motor fuel from wood augmented the gasoline needed for the Nazi army's airplanes, tanks and motorized divisions. The alcohol was used also in making smokeless powder and synthetic rubber. Textile fibers made of wood (wood wool, wood cotton and wood silk) were used for clothing. Cattle were fed on ersatz fodder made of wood. Sugar was compounded of sawdust, and so were explosives. Airplanes were built of plywood and wood plastics were used in place of scarce metals. Even heavy lubricants were made of wood; so was chocolate candy. German chemists even produced an ersatz bacon made from chips.

So much did the German plan for world domination depend on these wood-based ersatz industries, it was asserted, that Nazi control over the world's forests and forest industries was one of the primary objectives of the war. As far back as 1927 Goering came out with the assertion that Germany could stand on its own economic and industrial bottom by manufacturing all needed commodities from wood. Germany's timber supply was not sufficient to her needs, he admitted, but that deficiency could be remedied by expansion. The Nazis, alive to the supreme importance of wood, could get far ahead with their plans for gobbling up control of the world's timber supply while the other nations slept. Goering's technical advisers were quoted in sup-

port of the startling and revolutionary theory that "wood is the natural raw material of modern humanity living in the temperate zone." The thought was summed up by the German omnibus-word *Universalrohstoff*—the material which can produce anything.

All Hitler's expansion moves after that time, according to Dr. Glesinger's theory, were in pursuit of this plan. Control of Europe's wood supply was seen as the key to the Nazis' whole plan of world domination. In the improbable event of a negotiated peace it would make it possible for them soon to unleash another attack on civilization. That, briefly, was the story.

To most Americans it sounded fantastic. Nations have waged wars in the past for various reasons—personal ambition, lust of power, hunger for territory—but nobody ever fought to obtain possession of a glorified woodpile. They might go to war for gold, but surely wood is not important enough to fight over. Anyhow, could you really make all those ersatz products out of wood and get along without the things they replace?

Probably Dr. Glesinger, well-informed as he is, exaggerated what the Nazis were actually doing. There was a strong popular tendency to overplay the Germans as superscientists. But the idea is not entirely fantastic. In these fast-moving days we have learned not to be too quick about deciding that anything is out of the question. The impossibility of yesterday is the accepted reality of today. As far as those ersatz products from wood are concerned, they are not entirely news to Americans who have kept in touch with our own scientific developments. There is some foundation for the *Universalrohstoff* idea, but the Germans have no monopoly on wood technologists. Our scientists too have been showing us a lot of new things about the properties and possibilities of wood. Our chemists are just as clever as the German chemists. We are already beginning to use wood to better advantage; and, best of all, we have an abundant supply of it.

Wood, we are beginning to realize, not only can be sawed into lumber, it is one of our most plentiful and adaptable primary chemical substances. It is a combination of solids and fluids and gases, of atoms and molecules—a complex, organic whole built up of many magical parts which can be analyzed, rearranged, combined and recombined to create nobody knows how many new products. The tree itself is a wonderful chemical laboratory. Of all plants it is perhaps the most efficient converter of solar energy. Light falling on its green, chlo-

rophyll-bearing, leafy surfaces brings about through the mystery of photosynthesis fusion with moisture and the carbon-dioxide molecules of air to produce in the tree the raw sugars and starches that are the stuff of organic life. Now our laboratory workers and research chemists are prying into the make-up of wood, the product of the tree, in an effort to develop its greatest usefulness.

Chemists have long been fascinated by the wood cell. They know, broadly, that it has two main components: cellulose and lignin. Cellulose makes up about two-thirds of the cell; lignin is the binder that holds it together. They have determined the atomic structure of cellulose and so been able to develop a wide variety of uses for it. It furnishes the basis of our refined paper pulps and a growing modern family of products such as rayon, cellophane, lacquers, photographic film, gunpowder, and a long list of nitrate and acetate plastics. But chemists of vision say we are only standing on the threshold of cellulose development. They look on it as the coming new material of modern industry. They say the "age of steel" will be succeeded by the "age of cellulose." And cellulose fiber can be produced and harvested more economically in trees than in any other commercial form.

Lignin remains more or less of a chemical mystery. Vast quantities of it have been wasted in extracting the useful cellulose from the wood pulp. Little by little, however, chemists are drawing the lignin secret from the wood fiber, and already it emerges as a potential source of cheap and plentiful plastics.

Foremost among the scientific organizations devoted to research is the Forest Products Laboratory, maintained by the United States Government at Madison, Wisconsin. Somebody might ask: Why should the Federal Government spend any of the taxpayers' money to maintain an experimental laboratory designed to improve the utilization of forest products? The Government would answer by pointing out that it is committed to a policy of timber conservation and that utilization is an essential feature of any conservation program. "The mere production of an increased timber supply does not satisfy the demands of economic forestry," it says. "The utility value of wood must also be maintained and increased. From this standpoint the actual and potential value of timberlands as a source of wealth and employment must be gauged in a large measure by the utility value of this principal product. The better adaptation of wood

to modern consumption requirements is a matter of direct concern to consumers, whose proper housing and standards of living are bound up with the satisfactory use of wood products; to workmen, who need the hundreds of millions of dollars in wages furnished by employment in the woods, the sawmills, the pulp mills, and broadly diversified fields of wood construction and manufacture; to farmers and other timberland owners, large and small, seeking market outlets for materials from their vast aggregate acreage of woodlands; to local communities, counties, states and the nation, all of which have a vital interest in stable revenues from forests, forest lands and successful forest industries."

Handicapped by inadequate appropriations, the Laboratory has never been able to attain the full measure of its possibilities, but it has accomplished enough to open the eyes of forest industries to the practical, dollars-and-cents value of research work. During World War II it made its value evident in a number of very practical ways, notably in developing the best possible designs and specifications of boxes and crates for loading and packaging ordnance equipment and munitions—tanks, guns, shells, rifles and other combat materials.

These precious materials must be packed so as to arrive whole, free from moisture, rust and decay, be readily and quickly accessible, protected against pilferage, and be packaged to conserve weight, lumber and vital cargo space. Hundreds of thousands of items are involved and in practically all cases it was possible to develop better packages than were used before, with savings of from 5 percent to 30 percent in cargo space and even greater savings in lumber. For instance, the World War I howitzer case weighed as much as the gun it enclosed. By redesigning, the weight of the crate was cut down 50 percent. Such changes saved thousands of tons of valuable shipping space—an important item when under U-boat attack. The Laboratory has a box-testing machine—a giant wheel-shaped affair in which packed boxes are tumbled and dropped and manhandled to simulate the roughest sort of handling in actual shipment. If a box does not stand up it is redesigned; if it survives the test it is strong enough to carry its contents to Australia or Iceland or Korea—or any other country.

In response to the increased demand for dry lumber for war purposes, the Laboratory reduced the bottlenecks in deliveries by developing accelerated kiln-drying methods. They reduced the drying

time of three-inch Douglas fir pontoon stock more than half—and at the same time materially reduced degrade; drying time for walnut gunstocks from seventy to forty-five days; maple shoe-last blanks from sixty days to forty-five.

The Laboratory's pioneer engineering work in laminated glued-up arches resulted in their commercial production by a number of factories and the construction of literally hundreds of buildings with laminated wood instead of steel. War production was speeded by these buildings, as well as by buildings constructed with the ring-connectors, about which engineering data have been worked up by the Laboratory.

The discovery of urea-plasticized wood in the Laboratory's war-time experimentations is interesting, though so far put to only limited practical use. It was found that wood, especially oak, which has been soaked in a concentrated solution of urea and heated to 212 degrees becomes plastic. It can be bent, twisted or even tied into a knot. It resumes its normal hardness and rigidity when cooled, retaining its altered shape unless reheated. A refinement of the process consists in soaking the wood in urea aldehyde, which causes the bent or twisted wood to hold its shape permanently once it is cooled even though it is reheated. This plasticized wood appears to have great possibilities.

Especially fascinating among the Laboratory's discoveries, and one opening up almost unlimited fields, is "compreg"—a dimensionally stable form of compressed wood. It is produced by the compression of impregnated layers of hardwood veneer, whence its name. Compreg is the outgrowth of the original type of resin-bonded plywood, which has been on the market for some time and in which the resin not only acts as a bonding agent between the plies of wood but also penetrates the cells. In making compreg the veneers are impregnated with the resin, then laid up in assemblies of the desired number of sheets and subjected to heat and moderate pressure. This process squeezes the sheets of wood into half or less of their original thickness, depending on the species, and greatly increases the density, hardness and resistance to moisture, shrinking and swelling. The result is what might be called a sort of wood alloy, a stronger, more stable and more durable material than the wood in its original form. By varying the number of plies in the assembly, a piece of the same thickness may be rendered denser at one end than at the other. This

is valuable in making airplane propellers, which need to be heavy at the hub and light at the tip. It has a naturally hard, glossy scratch-proof surface, impervious to alcohol and resistant to burning, and thus seems to promise usefulness in construction and furnishing.

Though new in the forest-products world, compreg has already moved out of laboratory experimentation into industrial production and is now being made and sold commercially by a half-dozen companies. Commercial compreg varies in color from yellow to dark brown, depending on the species, and carries a typical wood grain with a high, permanent gloss finish that is practically immune to wear and exposure. This high-density wood in its completely compressed form weighs about half as much as aluminum and one-fifth as much as steel. In general, it combines the better qualities of wood and metal, and metalworking tools are required to handle it. It can be sawed, drilled, turned, threaded, milled and tapped. It is highly resistant to decay and also to fire.

In peacetime the helpful discoveries of the Forest Products Laboratory have been along many lines. Prominent among these have been its studies in pulp and paper. The great kraft pulp industry of the South, dating since 1910, is based on the Laboratory's development of a means of making satisfactory brown kraft pulp from the Southern pines. Later the Laboratory worked out methods of cooking and bleaching to produce a white pulp, and proved the use of Southern gums and other hardwoods entirely feasible for book and similarly bleached grades of paper. The first Southern newsprint paper mill, now in operation in Texas, is using a procedure recommended by the Laboratory: semibleached pine sulfate mixed with pine groundwood.

Going further, the Laboratory has worked out a "semichemical process" by which black gum and red gum are cooked to produce a pulp to replace the much more costly semibleached kraft pulp. It was evolved about twenty years ago to make corrugated board and liner for shipping containers from waste-extracted chestnut chips in the tannin industry. As the chestnut supply is being depleted, the Laboratory has shown how blackjack oak and other hardwoods may be reduced by the same process, and a container board result of a quality superior to that from extracted chestnut. Recent developments in the bleaching and purification of these semichemical pulps have greatly improved the adaptability of hardwoods to the better grades of paper.

Then there is the "wood hydrogenation" process. By it the hemicellulose and lignin, which constitute from 50 to 60 percent of the wood substance, are converted into a variety of alcohols, oils and an alkali-soluble resin, at the same time recovering the cellulose in the form of a pulp. The alcohols include methyl and propyl, and among the by-products are some previously unknown substances. One of them is a hard, glassy, amber-colored resin that may prove useful for plastics and lacquers; there are also several derivatives of propyl cyclohexane, some of which are thick viscous oils and others thick and toxic in nature.

In a world which looks to a "plastic age," the Laboratory has helped things along by its discovery of a process of making low-cost plastics from poor-quality and waste wood. This offers a way to utilize many species and many defective trees that should be harvested to make room for a new crop of timber of desirable species, but which won't pay their way when manufactured into standard lumber. The essentials are simple. Sawdust or wood chips are "hydrolyzed" by heating with dilute sulfuric acid. The fibrous mass is then dried, ground fine and mixed with a small amount of aniline and furfural or other plasticizing materials. The result is a molding powder which under pressure becomes a dense, impervious material with extensive possibilities for the manufacture of pressed and molded products. And the powder can be made at three to eight cents per pound as compared to about sixteen cents per pound for the well-known phenolic plastic.

Many other Laboratory accomplishments are of great practical importance to larger and better wood utilization. Its logging cost and value studies have shown that to cut trees below certain diameter limits for lumber is not only unprofitable but also bad for growing the future forest. These findings form the basis for "selective logging" practice, now increasingly applied to commercial forest lands. Its experts have been working out a truly portable band sawmill—still in the experimental stages—which may be moved and operated by a tractor, will not require costly "re-setup" expense, and will cut even-thickness boards without the loss that comes from the wasteful circular saw. They have established the principles and working stresses for structural timber grades for all species throughout the country. They were pioneers in the development of a low-cost prefabricated system for wood housing and other buildings, using plywood glued to

light framing for the construction of unit panels for walls, floors and roofs. The engineering features have proved sound and the unit panels well adapted to factory construction.

The director of the Forest Products Laboratory is J. Alfred Hall, recognized in scientific circles as an outstanding authority on scientific wood utilization. He is assisted by a staff of specialists in the Laboratory's various endeavers. Most of them work along year after year in quiet anonymity, their accomplishments known and appreciated in their particular fields but never given public recognition. Occasionally one bursts out in headline publicity, like Arthur Koehler when he testified in the Lindbergh trial and sent the carpenter-kidnapper to the electric chair; but mostly they and their work are unknown to the public which is the eventual beneficiary.

The Forest Products Laboratory at Madison is the foremost institution of its kind in the country, but it is by no means the only one. Some states and some schools carry on such work. An interesting regional activity is the Wood Products Laboratory maintained by the University of Florida at Gainesville. Its object is to demonstrate practical methods of the best possible utilization of wood. Special emphasis is placed on proper conditioning for yard seasoning and for kiln-drying—with a kiln donated by the Moore Dry Kiln Company; also on such information in timber physics as deals with the internal stresses of tension and compression. This laboratory, too, is conducting an elaborate investigation of the comparative durability of treated and untreated wood, with "graveyard tests" in the open air.

One of the state-maintained forest-products research laboratories is that of Oregon, maintained at Corvallis. Its principal objective is the utilization of wood waste. Its outstanding wartime study was in the possibility of producing cork from Douglas fir bark. The war interfered with the importation of cork from the usual sources, but the research at Corvallis indicated that very satisfactory cork granules can be made from fir bark and that a composition cork can be made from these granules under proper conditions.

There are besides specialized activities along related lines maintained by individual firms and organizations in the forest-products industries. One of the most successful is the laboratory operated by the Western Pine Association at Portland, Oregon. This active and aggressive organization launched a modest research program twenty-

five years ago, with a one-man staff. At that time it was a pioneering enterprise, first activity of its kind in the lumber industry supported entirely by private funds. It was a unique departure from past practice in the lumber trade, and it was not undertaken without some misgivings. The measure of its success is attested by the fact that today it occupies a large, well-equipped, modern laboratory building. The staff has expanded to seven scientifically trained technicians, under the direction of Albert Hermann, an able wood technologist. It can look backward on a record of accomplishment as well as forward to the fruition of the various studies it has under way.

It required vision to launch an undertaking of this kind more than two decades ago, when research had not come to be recognized as such a potent force for business betterment. But the Western pine industry had that vision and they were willing to spend their money to back it up. They realized that in order to offset the claims of values in new competitive materials, manufactured largely under laboratory control, it was vitally necessary for them to have more comprehensive, basic information on the properties of their own product—Idaho white pine, ponderosa pine and sugar pine. Then, too, the problems springing from the use of their lumber in home construction, on the farm and by industry brought out clearly that they lacked adequate and reliable data to insure best performance under all conditions. Research seemed the logical answer.

A major objective of the staff has been to improve the methods of seasoning the three important species of pine the mills manufacture. Among all lumber manufacturers and users, the seasoning practice in the Western pine industry has always been considered outstandingly good. But, good as it is, it is not perfect; and true laboratory technicians are perfectionists. So the staff continuously devotes itself to research which will make it possible for the mills to produce lumber uniformly dried and of the moisture content required for the principal uses. In addition, it aims to improve procedures so that internal seasoning stresses, checks, warp, checked knots and discoloration of the lumber may be avoided. The work is not all done in the laboratory either; the staff spends a good part of its time at the plants of the association members, putting their theories to the acid test of commercial practice.

Another specific objective of the laboratory is to obtain and compile exact practical data on the physical, chemical and mechanical

properties of each of the three Western pines to the end that fabricating industries or ultimate consumers may avail themselves of this information to the best advantage. This sounds simple; but for all its long-time record of service, there is still a lot to be learned about the properties of wood.

One phase of the laboratory work is to evolve and make known to users of Western pines any special chemical treatments like stain preventives, wood preservatives, water repellents or paint applications that guarantee better performance under difficult conditions. In acting as a clearinghouse for problems and service complaints it is possible for the association laboratory to investigate and help eliminate grounds for any complaints against Western pines in the hands of uninformed users.

Further, the research program provides for time spent in trying to find new uses for which the Western pines may be peculiarly fitted and new forms or types of product which will utilize a greater proportion of the log and thereby increase the usable yield of the forest. Opportunities as yet unknown may lie ahead in new products and new markets traceable to these studies.

Several projects have already been completed by the research laboratory. Its experts have gathered detailed information on the shrinkage and swelling characteristics of Idaho white pine, ponderosa pine and sugar pine as related to the variables that affect them. They have determined the proper rates of dry-kiln circulation for maximum performance at minimum cost—no small matter in itself. Principal dry-kiln design factors affecting performance, particularly with reference to quality of seasoning, have been evaluated. Design data on the most efficient dry-kiln fans have been gathered. Commercial blue-stain preventives have been checked and rated. The strength of wood matches—one of the largest uses of white pine—has been tested.

One of the outstanding accomplishments of the laboratory was the development of the "Permatol" preservative treatment of exterior millwork. Subsequently the formula for Permatol—which is a pentachlorophenol preparation—was made available to the nation's manufacturing chemists, and since then "penta" products have been commercially produced under more than a score of trade names. The treatment has been adopted as standard for toxic treatment by the National Door Manufacturers Association and by several departments of the Government.

Another notable contribution is the laboratory's investigation and practical demonstration of the performance of ponderosa pine heavy-duty floors, as in docks, warehouses, platforms, trucks, railroad cars and similar locations. This has opened up an entirely new market, expected to run into considerable volume as the results become better known.

Almost the equal of Permatol in public acceptance has been WP-578 knot sealer, a synthetic resin liquid developed by the laboratory after four years of research. The sealer stops the leaching of pine knot resins through paint for the normal span of time between paintings and thus makes possible the use of more economical and more readily available common grades of siding. Announced in 1945, the WP-578 formula was made available to paint and varnish manufacturers without charge and is now being produced by more than 90 of the nation's leading paint companies, production having nearly doubled each year since 1945.

In 1951 the laboratory has succeeded in producing a pigmented WP-578 which laboratory tests indicate is superior to the clear preparation in durability. Now about to undergo field tests, pigmented WP-578, if successful, will save one step in the painting process by eliminating separate sealer and prime treatments.

Other current research projects include stress studies of inland Douglas fir, brown stain analysis, log blue stain study, analysis of larch extractives, development of machinery for the utilization of low grades of lumber, the relationship of degrade to moisture content in kiln-drying and a study of plant operations.

Individual firms in the forest-products industries have been active in applying research to their business. The foremost example may be seen in the $100,000 laboratory which the Weyerhaeuser Timber Company maintains at its plant in Longview, Washington. A modern, thoroughly equipped research plant is testimony of the company's confidence in the future of the forest industries. A staff of analytical chemists conduct here methodical exploration of the possibilities of that great, natural, renewable resource—wood.

The Weyerhaeuser interests are no Johnny-come-latelys in scientific research. They have been at it for years, and what they achieved by it encouraged them to erect this laboratory. More than thirty years ago they began looking about for ways to utilize wood waste

by developing new materials. The result was the discovery and commercial production of an effective insulating material, one of the pioneers in the now great insulating industry. This material, along with an elaborated line of fiber-board building materials, is made by a subsidiary organization, the Wood Conversion Company, and was used extensively in putting up the laboratory. Another product employed in the construction, laminated wooden girders, is manufactured by another Weyerhaeuser subsidiary, Rilco Laminated Products, Incorporated, a company formed a short while ago to give commercial attention to the new discoveries in the field of glued-up arches, girders and other structural members.

The Weyerhaeuser Company carried on pioneer studies in the utilization of wood in various lines, notably in boxing and crating. Making a box may seem a simple thing, but through research they learned how to make a stronger box with less lumber. The company gave wide publicity to their discoveries, to the benefit of lumber buyers and users. From such small beginnings their research program grew and expanded to its present proportions.

The principal thought behind the laboratory at Longview is the Weyerhaeuser conviction that there are new values and more widespread uses to be developed from our forests, now that the obscuring curtain is being drawn away by the expanding power of scientific knowledge. The research staff is undertaking to explore the commercial possibilities of wood from the standpoint of the chemist, the physicist and the engineer. The laboratory technicians lay stress on their point of view that "this is not a venture in laboratory research. It is a process of development of things and methods on a practical plane kept firmly anchored to a commercial world." The attitude is emphasized by the designation of this activity as the Development Department of the business, and its fundamental objectives are outlined as: protection of the present business, as dependent on maintenance of the quality of the present types of products; expansion of the present business; and development of new business—new products, new production methods and machines, and more complete or efficient utilization of the raw materials. Back of it all is the intent to stabilize and increase employment.

A dynamic and productive research is that of the Douglas Fir Plywood Association at Tacoma, Washington. At the head of it is

Managing Director O. Harry Schrader, Jr. The association's knowledge of synthetic resin glues and the performance of resin-glued plywood has been greatly increased by the work of its research organization. Glue-line studies have involved making as many as 150,000 plywood shear tests in a year, and have led to the most elaborate system of glue-line exposure fences to be found anywhere in the country.

In the shear tests one-inch-by-three-inch samples are sawed from big commercial-size panels selected at random. They are subjected to alternate boiling and drying, in a "torture test" which is considered to be an exaggeration of the most extreme conditions under which the material will be used, and are then broken along the glue joint. The requirement is that the glue line must be stronger than the wood itself.

The three exposure fences maintained by the researchers are located in climatically different sections of the country. Thousands of plywood samples are tested for the effects on the glue-line of exposure to the weather over a period of years. The principal field location is near Puyallup, Washington, where several acres are covered with the so-called fences upon which are hung samples dating as far back as 1938. They are constantly being supplemented by new samples of current production. The original laboratory tests are here compared with the severe outdoor tests of exposure to alternating rain, snow and scorching sun.

The association's research involves other studies of a long-time nature, such as those dealing with painting and sealers, and investigations of new uses for plywood in the way of specific products. An interesting phase has been the container program—the designing of new plywood boxes to carry gasoline, oil and chemicals.

Some of the research has been given to small agricultural buildings made of plywood, including an all-plywood farmhouse which can be built at low cost. These projects are conducted in co-operation with prominent agricultural schools and with the Forest Products Laboratory, which in 1935 designed the first all-plywood prefabricated house of glued construction.

The latest research program is that of the Timber Engineering Company of Washington, D.C. It is designed to develop new uses for wood, uses for wood derivatives, and means of improving on older

methods for the use of wood. The immediate ends are: To compile and analyze existing fundamental research for maximum forest-products development; to provide a clearing agency within the industry for information on lumber and forest-products research carried on within the industry and outside it, and to encourage the industry to use the knowledge and facilities now available; to aid individual groups or companies in researches; and to direct and carry on research projects as may be designated by the directors.

To provide facilities for research in behalf of the industry, the Timber Engineering Company has erected a laboratory and shop on a site in Washington. In reality this is two separate laboratories: chemical and physical or mechanical. To conduct the work a suitable staff of chemists and engineers has been assembled. This research program, the first to be undertaken on a large scale in behalf of the whole lumber industry, is directed by Carl A. Rishell, a trained forester, engineer and wood technologist.

All these activities give substantial evidence of a new vision in the forest-products industries. The amazing possibilities of wood as a basic raw material have awakened faith in the future, a realization that a tree's utility value is not limited to the traditional products which have been coming from the mills for three centuries.

There is growing interest in the utilization of waste. The extent of it in the conversion of the standing timber to the usable product is staggering. Of a felled tree only 33 percent actually gets into lumber. The rest is wasted, in the following ratio: woods waste (tops, limbs, stumps, etc.), 25 percent; mill waste (bark, sawdust, slabs, edgings, etc.), 37 percent; seasoning waste, 5 percent. Much of this waste has been unavoidable, much due to the fact that there was no way of profitable salvage. Sawmills could use some of it as fuel under their boilers, but most of them still had waste to burn—literally to burn, in screened-off, perpetually smoldering slab piles, or in monumental refuse burners whose glowing, volcanolike tops were long a feature of the nighttime landscape in the sawmill country. Nowadays there is less and less material being burned. There is more and more interest in the utilization of waste.

In fact, the "waste" material of the sawmills is now becoming so valuable that some operators are buying coal and other fuels for their boilers to utilize in more profitable ways their sawdust, slabs and

other material once considered worthless. The time may come when no lumber manufacturer will be able to afford the luxury of wood for fuel in his sawmill.

Take, for example, the item of sawdust. Not less than 13 percent of every saw log goes into it. Sawmills destroyed millions of tons of it because there was nothing to do with it after they had burned some for fuel and perhaps sold a few wagonloads to the local livery stable. Portable sawmills left mountains of sawdust behind them all over the country as they moved from place to place.

Now progressive-minded operators discover that there are uses for it—to make oxalic acid, acetic acid, methyl and ethyl alcohol, and wood sugar. The wood-sugar and alcohol production methods came into prominence during World War II. There are several processes by which they can be satisfactorily made from sawdust and other wood waste. One of the most promising processes is the Scholler-Tornesch, known in Germany as far back as World War I. With the Bergius process, it was the mainstay of the German production.

Another method which has caused much favorable comment is the so-called American process worked out by Dr. D. F. Othmer of the Brooklyn Polytechnic Institute. By it 100 pounds of sawdust, treated in the laboratory with such staple chemicals as sulfuric acid, lime and lye, will produce 112 pounds of oxalic acid, 20 pounds of acetic acid, 4 pounds of formic acid and 6 pounds of alcohol.

Then there is wood flour, of which our prewar imports ran as high as 10,000 tons annually, in addition to our domestic production. It is nothing but finely ground sawdust—dry, screened to specific mesh, free of bark, etc.—but it sells for $32 a ton. Some sawmill men are beginning to wonder if it might not pay them to substitute a pulverizer and refining equipment for the ever-burning sawdust fire at the tail end of the mill. If American manufacturers need 10,000 additional tons of wood flour every year, why should they have to send to Scandinavia for it? Our production almost doubled in 1939 over 1937, and is still growing.

Out west an increasing number of sawmills use their sawdust, hogged chips and shavings in the manufacture of synthetic logs about four inches in diameter and 12 inches long which may be used in fireplaces or stoves in place of coal or wood. The basic material is automatically fed into a patented machine which applies a pressure of about 20,000 pounds to the square inch and converts the loose

stuff into a dense, compact, efficient form of fuel. The "logs" have a heat value of from 8,000 to 10,000 BTUs per pound, and possess the added advantage of convenience, cleanliness and small percentage of ash. There are more than a dozen plants in the West and one in the South now making them, and they all enjoy a good demand.

Then there is bark. Aside from the traditional use of some species for tannic-acid extraction, nobody ever thought of the bark on a log as anything but a troublesome and unavoidable waste. Two or three years ago a redwood manufacturer in California conceived the idea of using the bark to make an insulating material. He set some research chemists to work and they evolved a process of exploding the bark to get just what he was after. As an incidental and unexpected by-product they produced also fiber which is already finding place as a textile. Samples of the cloth so far turned out—a mixture of 25 percent to 50 percent shredded bark with virgin wool or shoddy—are rated as warm as 100 percent wool fabric, and the cloth is not so expensive as all-wool. Redwood bark is also used in the manufacture of a gardeners' mulch similar to peat moss.

The possibilities in utilizing our wasted lignin are so vast as to challenge the imagination. So far our scientists have only scratched the surface, and already the outlook is wonderful. In past years our wood-pulp mills have sluiced millions of tons of lignin down the sewers in the form of waste liquor. It might entirely revolutionize our chemical industries if we should salvage this waste and augment it with more millions of tons of lignin that may be derived from the waste of sawmills and other forest industries.

Our chemists have not been unaware of the potentialities. They have been working on the lignin problem for years, and they have made more progress than any of the foreign chemists. Owing to their work, lignin is today being used for the preparation of road binders, cement-setting accelerators, cement-disbursing agents, tanning materials, vanillin and accompanying chemicals, water-purification agents, etc. Lignin is also finding a place in the plastics field.

The production of industrial alcohol from wood waste is another intriguing possibility, emphasized by our war needs. During the last war we had a successful plant making industrial (ethyl) alcohol from the sugar resulting from the hydrolysis of wood in a sulfite pulp mill. We had two plants making ethyl alcohol directly from wood. These were emergency plants and were discontinued after the war as they

could not be profitably operated in competition with ethyl alcohol made from molasses. But our chemists know how to make ethyl alcohol from wood if they have to do it again.

In some instances the experiments of lumbermen with the salvage of waste have burgeoned into industries of unexpected proportions. This is true of the widely used Masonite hardboard, manufactured at Laurel, Mississippi. It is a hard, stiff, grainless material, somewhat inexactly called "synthetic lumber." Consumption of it runs into millions of square feet every year. Most of it is used in sheets ⅛ of an inch thick, but it may be laminated into pieces of any desired thickness. Originally designed as a means of utilizing waste from the big pine sawmills at Laurel, the Masonite operation quickly outgrew its status as a sideline into one of the nation's greatest new building material industries. It no longer depends on sawmill waste for raw material, but purchases cordword from near-by timberland owners, and to insure a permanent supply is preaching conservation and encouraging sustained-yield forestry.

In the Masonite process the wood is first ground up into chips, which are then exploded in "guns"—like the well-advertised breakfast food. The explosion, under about 1,000-pound steam pressure, tears the chips into tiny shreds of fiber which are then further refined and finally felted and pressed into sheets under heat and pressure. A somewhat similar type of hardboard is made by the U.S. Gypsum Company from ground-wood fibers. They are high-pressed into a hardboard by binders and hardening oils. A synthetic hardboard has been developed in the laboratories of the Elmendorf Corporation of Chicago which eliminates the felting process, also the use of binders or plasticizers. It is made entirely of wood waste.

Such highlights in chemical utilization are mentioned to indicate the possible changes in the pattern of the future use of wood. It would be a mistake, however, to overemphasize this factor. It is true that the lumber industry, as a whole and as individuals, is giving careful thought to the integration of waste-saving with its traditional processes, and the war spurred them on. There is so much news value in it and so much publicity has been given to it that some people have been misled into thinking that the time is just around the corner when all the forest resources will be channeled into the manufacture of chemical and synthetic materials, and that lumber as we now know it will be a thing of the past. Confusion as to the future

lumber supply has been created by loose talk about the so-called destruction of the forests, with implications of a possible timber famine. Some alarmists made capital out of the heavy demands for lumber in the war. It was charged that the forests were exploited at an unconscionable rate, and it was implied that lumber would be a mighty scarce article when peace was restored. Small wonder if the lumber-buying public was dismayed. But there is no real cause for alarm; today there is available an ample supply of lumber for all civilian and military needs. There may be changes and improvements in our methods of utilizing wood in the future. There will be no lumber famine.

The prospect for wood chemical industries and synthetic material production is based largely on the utilization of wood waste—waste which will come from the production of lumber in its traditional forms from the saw log as the basic raw material. The by-products may take the form of plastics, alcohol or other chemicals, improved fuels or synthetic building materials—but the home-builder and the industrial plant will still be able to buy boards and two-by-fours and timbers, just as they always have been.

As to the alarmists' charge of excessive timber cutting for military purposes during World War II, two answers might be made: (1) The charge could not be sustained; and (2) if true, what of it?

In the first place, the needs for forest products, great as they were, created no very serious additional total drain on the timber supply. It is true that greatly increased quantities were used in the war effort, but it is also true that most of it was merely diverted from ordinary peacetime civilian uses and that the total amount of lumber consumed was but little greater than it was before the war started. Official census figures show a total production of 36 billion board feet in 1942, 34 billion in 1943, 32 billion in 1944 and 28 billion in 1945—as compared with 33 billion in 1941.

On the other hand, regardless of the drain, if we needed the forests to wage the war then it was proper that we should use them—and to whatever extent was necessary. It would have been criminally unpatriotic to refrain from cutting timber to make the lumber required by our fighting forces merely to sustain some prewar theory of conservation. All other available raw materials—all limited in supply and nonrenewable—were used lavishly and without stint, and this was as it should be. The main reason for conservation is utilization.

There is no point in saving for a rainy day unless we draw on our savings when the rainy day comes.

If there was any abnormal drain on our timber, we can absorb it far better than we can any of the other deplorable consequences of war's destructive blast. Above all, we can take consolation in the fact that timber is the one resource that can be replaced, the supply of which can be restored and increased.

The timber situation in the United States is not perfect, but it is better than most people think. Wisely protected, harvested and used, we have enough for our present and our apparent future needs —and we can increase the supply.

During the war we had plenty of timber to build the ships and trucks and airplanes and barracks; plenty for the gunstocks and boxes and tent pegs. And when peace was restored there was plenty more left to supply lumber to rebuild the world and to produce whatever other products science may derive from our 630 million acres of forested land. There will always be lumber.

APPENDIX

I

LUMBER PRODUCTION

LUMBER PRODUCTION BY STATES: 1947, 1946 and 1945
(In thousands of board feet, lumber tally)

State	1947	1946	1945
United States	35,404,212	34,112,357	28,122,344
Alabama	1,794,961	2,158,123	1,585,079
Arizona	220,017	240,725	157,984
Arkansas	1,285,315	1,244,655	1,090,173[1]
California and Nevada[2]	3,408,522	2,681,173	2,260,792
Colorado	144,966	138,806	88,059
Connecticut	20,306	16,728	17,361
Delaware	33,644	28,244	22,138
Florida	533,579	593,357	484,525
Georgia	1,687,414	1,981,881	1,510,080
Idaho	950,791	863,964	780,453
Illinois	99,764	92,620	65,836
Indiana	180,266	163,319	147,051
Iowa	45,093	47,180	73,292
Kansas	17,581	10,787[3]	13,409[3]
Kentucky	438,722	414,026	421,326
Louisiana	1,269,380	1,065,506	1,024,078
Maine	459,271	411,205	363,608
Maryland	153,809	117,312	115,962
Massachusetts	132,244	117,923	88,490
Michigan	580,097	519,719	420,884
Minnesota	244,363	205,371	186,090
Mississippi	1,397,145	1,558,930	1,313,241
Missouri	259,380	256,975	240,516
Montana	499,959	413,859	341,749
Nebraska	3,300	(3)	(3)
New Hampshire	322,509	382,384	290,125
New Jersey	32,423	27,200	31,448
New Mexico	126,925	144,214	99,100
New York	383,271	317,382	283,478
North Carolina	1,539,656	1,613,561	1,214,918
North Dakota	627	627	0
Ohio	265,452	246,718	256,570
Oklahoma	82,793	87,550	(1)
Oregon	7,102,410	6,328,317	5,003,547
Pennsylvania	580,005	526,031	463,688
Rhode Island	2,544	2,545	1,809
South Carolina	871,014	1,000,795	726,707
South Dakota	58,358	53,062	45,263
Tennessee	665,437	892,947	627,223
Texas	1,346,746	1,343,247	933,101
Utah	38,423	49,821	28,831
Vermont	203,739	215,907[4]	195,315
Virginia	1,166,067	1,217,360	994,664
Washington	3,705,401	3,422,289	3,257,995
West Virginia	483,902	442,705	476,209
Wisconsin	485,806	391,853	316,078
Wyoming	80,815	64,071	54,099

[1] 1944 and 1945 data for Oklahoma, a small producing state, are subject to large sampling errors. Therefore, for these years, production for Oklahoma has been combined with that for the bordering state of Arkansas, and only the combined figure is published.

[2] Combined to avoid disclosing operations of individual establishments.

[3] 1943, 1944, 1945, 1946 data for Nebraska, a small producing state, are subject to large sampling errors. Therefore, for these years, production for Nebraska has been combined with that for the bordering state of Kansas, and only the combined figure is published.

[4] Data supplied by the Vermont State Forest Service.

II

LUMBER ASSOCIATIONS

The principal lumber associations, national in name and character, are the National Lumber Manufacturers Association, the National-American Wholesale Lumber Association, the National Retail Lumber Dealers Association and the National Hardwood Lumber Association.

The National Lumber Manufacturers Association is composed of regional associations of lumber manufacturers. In the following pages is given a brief sketch of these national organizations and the principal regional and species associations.

NATIONAL LUMBER MANUFACTURERS ASSOCIATION

The National Lumber Manufacturers Association was organized in 1902 as a federation of regional organizations of manufacturers of lumber and timber products. Its purpose has always been improvement of the services and advancement of the interests of the industry.

At the present time the following sixteen regional species and product groups are affiliated with the National Lumber Manufacturers Association: American Walnut Manufacturers Association, Chicago, Ill.; Appalachian Hardwood Manufacturers, Incorporated, Cincinnati, Ohio; Hardwood Dimension Manufacturers Association, Louisville, Ky.; Hardwood Plywood Institute, Chicago, Illinois; Mahogany Association, Incorporated, Chicago, Ill.; Maple Flooring Manufacturers Association, Chicago, Illinois; National Oak Flooring Manufacturers Association, Memphis, Tennessee; Northeastern Lumber Manufacturers Association, New York, N.Y.; Northern Hemlock and Hardwood Manufacturers Association, Oshkosh, Wis.; Northern Pine Manufacturers Association, Minneapolis, Minn.; Southern Cypress Manufacturers Association, Jacksonville, Fla.; Southern Hardwood Producers, Incorporated, Memphis, Tenn.; Southern Pine Association, New Orleans, La.; The Veneer Association, Chicago, Illinois; West Coast Lumbermen's Association, Seattle, Wash.; and Western Pine Association, Portland, Ore. These associations represent an underlying membership of about 2,500 companies, which produce nearly 60 percent of the national lumber output.

The National Association is incorporated and is governed by a board of directors, representing the regional associations. The president and executive vice president are the chief executive officers and derive their authority from the board of directors. Committees operate in the principal fields of activity of the association. These include the Committee on Building Codes and Trade Promotion, Committee on Forest Conservation, Committee on Lumber Standards, Committee on Economics,

Committee on Taxation and Tariffs, Committee on Public Information, Committee on Transportation and Committee on Foreign Trade.

In addition, there is an Advisory Committee composed of the chief executive officers of the regional associations which advises the board of directors and assists in co-ordinating national and regional efforts in the handling of industry problems.

The National Lumber Manufacturers Association limits its activities to matters of general interest to all of the industry; the regional associations concentrate their activities on problems of peculiar interest to their own groups.

To provide for the handling of problems which are common to part of the industry but not of uniform interest to all lumbermen, and to provide also for participation in certain activities by groups not eligible to support all the activities of the association, a subsidiary organization, the American Forest Products Industries, Incorporated, was established in 1932. This organization operates on a project basis and its revenues are based on support of particular projects by those interested. For example, when it appeared desirable because of earthquake hazards to promote the construction of wood school buildings in California, Eastern lumber manufacturers were not sufficiently interested to finance it and the activity was undertaken by American Forest Products Industries, Incorporated, and supported entirely by Western groups. Both organizations maintain their headquarters in the American Forest Products Industries building at 1319 Eighteenth Street, N.W., Washington, D. C.

NATIONAL-AMERICAN WHOLESALE LUMBER ASSOCIATION

The first organizations of wholesale lumbermen were local in character. Such groups were in centers of lumber distribution as early as the late seventies. In 1893 a meeting of wholesale lumbermen was held in New York, at which the National Wholesale Lumber Dealers' Association was organized. It adopted a broad program of activities of importance to wholesalers: relations with retailers and manufacturers, credits and collections, insurance, transportation and forestry; and it served the wholesale trade effectively for many years.

In 1898 wholesale lumbermen organized the Shippers' Association of the Pacific Coast, which was reorganized ten years later and changed its name to the Pacific Coast Shippers' Association. In 1920 the American Wholesale Lumber Association was organized as the outgrowth of the National Bureau of Wholesale Lumber Distributors which had been formed during the World War as an emergency organization to protect the wholesalers' rights before the War Industries Board. In 1923 this organization merged with the National Wholesale Lumber Dealers Association to form the National-American Wholesale Lumber Association, and a year later the enlarged group absorbed the Pacific Coast Shippers' Association.

The National-American organization interests itself in all industry problems affecting the distribution of lumber, "Efficient Distribution" being its formal and official motto. It has also continued the original organization's interest in subjects of broad interest to the whole lumber industry, and has participated in raising funds to carry on trade-promotion work for the maintenance and extension of the markets for lumber.

Sid L. Darling is secretary-manager of the National-American Wholesale Lumber Association, which maintains its headquarters at 41 East 42nd Street, New York, N.Y.

Regional Wholesale Groups

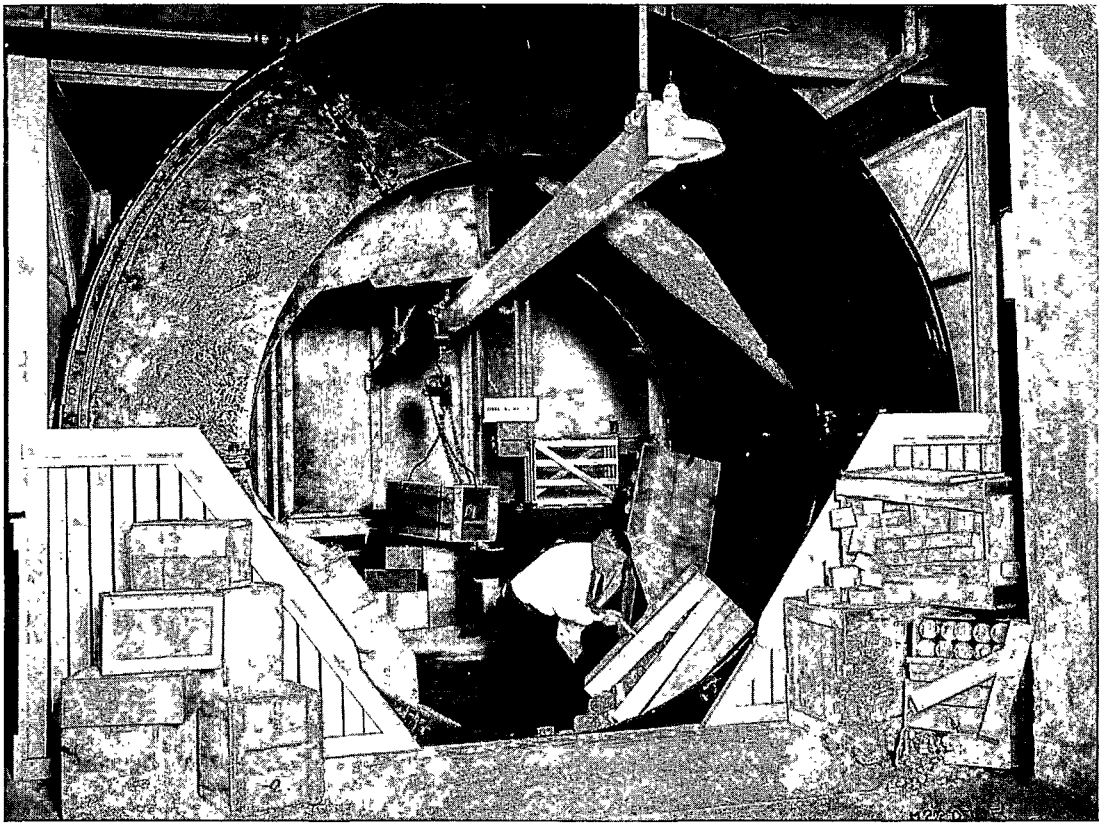
Other organized groups in the wholesale lumber field include the Southern Wholesale Lumber Association, R. F. Darrah, secretary, Livingstone, Ala.; National Association of Harwood Wholesalers, G. A. Vangsness, secretary, Chicago, Ill.; National Wholesale Lumber Distributing Yard Association, J. Jackson Kidd, Jr., secretary-treasurer, Baltimore, Md.; and the Pacific Coast Wholesale Hardwood Distributors Association, Milton Taenzer, secretary-treasurer, Los Angeles, Calif.

NATIONAL RETAIL LUMBER DEALERS ASSOCIATION

The National Retail Lumber Dealers Association is a federation of state and regional organizations of retail lumbermen. It was formed in 1916 as a means of bringing about the co-ordination of sales efforts and effective co-operation between manufacturers and retail dealers in the distribution of lumber. A declaration of business ethics and business methods was made at that time, but at first it operated simply as a national organization in behalf of retail lumber dealers. In 1932 the association was reorganized and a program was adopted to make more effective the activities of the state and regional associations of retail dealers, to encourage the efficient and economic distribution of materials handled by the retailers and to act as a spokesman in all national legislation affecting the retail lumber industry.

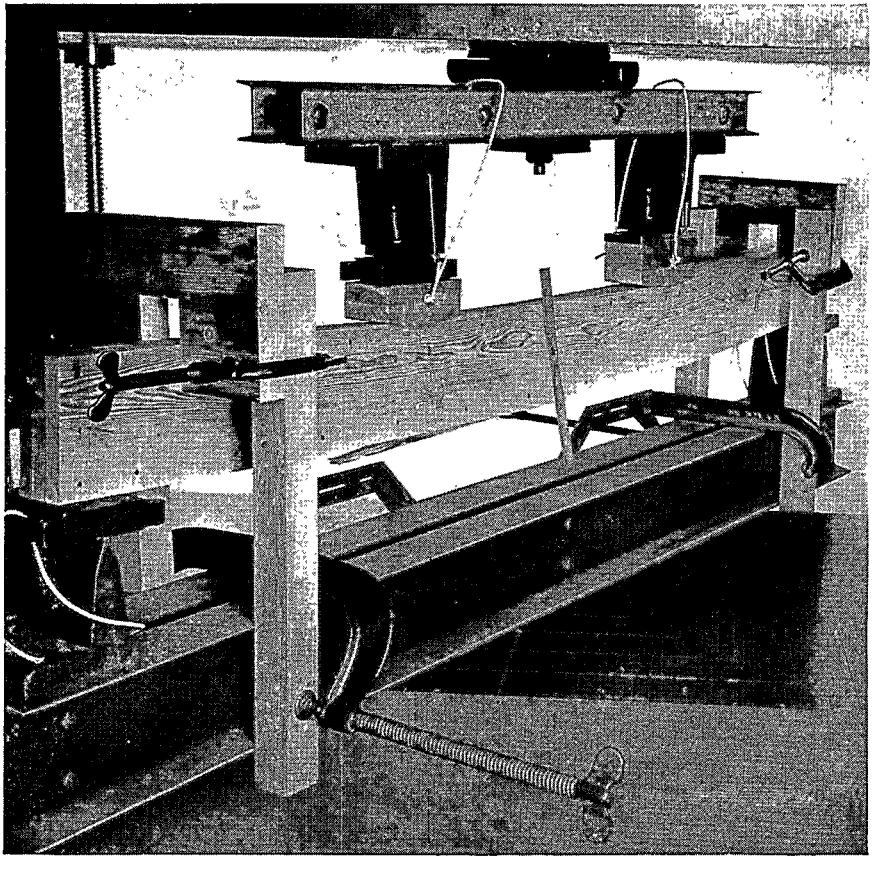
The governing body of the National Retail Lumber Dealers Association is made up of the secretary and one dealer member of each association affiliated with the National organization, and additional members are permitted up to a limit of one for every 300 members of the affiliated associations.

Local and regional associations of retail lumber dealers have existed since the early seventies. In 1876 a National Association of Lumber Dealers was formed, whose membership was made up mostly of retailers in Illinois, Iowa, Kansas and Missouri. It dissolved in 1888 but separate state associations were formed in the Mississippi Valley and some of them are still in existence. The New Jersey Lumbermen's Association has the distinction of being the oldest state retail lumber dealers' association in the country, having been organized in 1885. The oldest local organiza-



TESTING OF BOXES BY FOREST PRODUCTS LABORATORY

The Forest Products Laboratory tests boxes in this big tumbling device which simulates all the rigors of the most careless handling on the roughest trips.



TESTING THE BREAKING POINT OF A BEAM IN THE TIMBER ENGINEERING COMPANY'S RESEARCH LABORATORY

tion is the Cleveland Board of Lumber Dealers which was organized in 1866; the Lumbermen's Association of Chicago was formed in 1869.

The executive vice president of the National Retailers is H. R. Northup, and the association's headquarters are in the Ring Building, 18th and M Streets, N.W., Washington, D. C.

NATIONAL HARDWOOD LUMBER ASSOCIATION

Grading rules for all the softwood species of lumber are written and administered by regional organizations of manufacturers dealing with their respective species. In the hardwood field, however, the writing of grading rules and the official inspection of lumber is the function of the National Hardwood Lumber Association, an organization composed of manufacturers, wholesalers and industrial buyers of hardwoods. This is the only function of the National Hardwood Lumber Association, which maintains a corps of official inspectors, and has annual meetings to modify the grading rules if necessary. It does not engage in trade promotion, statistical work, or any other of the activities common to most lumber associations.

The inspection rules of this association are now recognized as the standard for the whole industry—but it was not ever thus. In the earliest days of the hardwood trade there were no grading rules at all, the product of the sawmills being sold on a "mill-run" basis to wholesale dealers and the larger consumers. Then there gradually grew up a system of local grading rules, each of several hardwood markets writing and enforcing its own rules. Efforts to draw up a single set of standardized rules were made at a meeting of hardwood manufacturers and wholesalers at Chicago in 1898, at which time the National Hardwood Lumber Association was formed. The rules adopted at the first meeting of this association were not acceptable to a group of manufacturers, mostly in the Southern and Central states, and they established the Mississippi Valley Hardwood Lumber Manufacturers Association and promulgated a rival set of inspection rules. Four years later it was reorganized under the name of the Hardwood Manufacturers Association of the United States. It set up a corps of inspectors and for more than twenty years maintained an inspection service in competition with the National. At last, however, in 1925, the long-lived hardwood grading rule controversy was ended by the abandonment of the manufacturers' efforts to sustain a rival service, and since then all factions have accepted the National rules as official.

John W. McClure is secretary-manager of the National Hardwood Lumber Association and its headquarters are maintained at 59 East Van Buren Street, Chicago, Ill.

AMERICAN WALNUT MANUFACTURERS ASSOCIATION

The American Walnut Manufacturers Association was crystallized during World War I when a small number of manufacturers were called

together by the Government to provide needed gunstocks and airplane propellers, uses for which the qualities of walnut render it ideal. Before that war the walnut business had been primarily export. Thus at the war's end there was practically no market; but an intensive program of consumer advertising and educational work by the association resulted in the development and maintenance of domestic markets which have re-established walnut as a most desired cabinet wood. Promotional work with consumers, supplemented by trade-paper advertising, work with designers, architects and others, as well as research in finishing, styling and merchandising have had very marked results. Today walnut is firmly established in the household furniture and executive office furniture field, and is used extensively as woodwork in the latest office buildings. Pianos have largely swung to walnut, and in radio cabinets walnut is the standard.

With World War II, walnut found itself going in modest amounts into the more exacting parts of aircraft, and used almost exclusively in the manufacture of gunstocks for all of the United Nations. Plastics and other substitutes have been found wanting, especially for the newly developed semiautomatic rifles, the Garand and the carbine.

During the past fifteen years a much greater percentage of the walnut industry's business has been in the form of fine veneers, supplementing its lumber production. Along with this the association developed and established the veneer grading rules approved by the United States Bureau of Standards, and maintains a Veneer Inspection Service for application of these standards.

Burdett Green is the secretary of the American Walnut Manufacturers Association, which has its headquarters at 666 North Lake Shore Drive, Chicago, Ill.

APPALACHIAN HARDWOOD MANUFACTURERS

This organization of operators in the Appalachian region devotes its activities almost entirely to trade promotion and forestry. Its objectives are to conserve the timber supply and, by advertising and personal interviews by field representatives, to acquaint the industrial buyers, architects and lumber specifiers with the advantages of using lumber produced in this territory.

The present association, styled Appalachian Hardwood Manufacturers, Incorporated, is the outgrowth of what was formerly known as the Appalachian Hardwood Club which was, in turn, an outgrowth of the Appalachian Logging Congress. Besides a secretary, it has a manager of trade promotion who, aided by a staff of field representatives, keeps in contact with lumber buyers throughout the Appalachian lumber consuming territory. It also maintains a forestry department devoted to the development of better forestry and logging practices on the part of the Appalachian operators. The membership includes a large proportion of the producers in the Appalachian region.

C. H. Clendening is secretary of the Appalachian Hardwood Manufac-

turers, and headquarters are at 1015 Mercantile Library Building, Cincinnati, Ohio.

CALIFORNIA REDWOOD ASSOCIATION

One of the most compact of all the lumber manufacturers' associations is the California Redwood Association, which has its headquarters in San Francisco, California. Its members are manufacturers of redwood lumber located in four counties of California: Humboldt, Mendocino, Del Norte and Santa Cruz. The industry is not only concentrated thus geographically, but most of the production of this species has always come from a relatively small number of mills, due to the fact that the large size of the timber does not make for efficient manufacture by small mills. The association's members have usually represented from 75 percent to 90 percent of the total redwood production, although their number has been only from a half-dozen to a dozen.

The primary function of the California Redwood Association has always been trade promotion, accomplished through various channels: space advertising to specifiers and consumers; trade promotional literature for them, distributed directly or through retail lumber yards; field work with architects, contractors, retail dealers and other buyers; maintenance of a technical service department, which acts as a consultant on the use of redwood. The association also furnishes grading rules and inspection service, promotes and encourages fire protection and selective cutting of timber, compiles statistics, looks after freight-rate matters, and renders other miscellaneous help to makers and users.

The chief executive officer of the California Redwood Association is Sherman Bishop, with the title of executive vice president.

HARDWOOD DIMENSION MANUFACTURERS ASSOCIATION, INCORPORATED

The Hardwood Dimension Manufacturers Association, Incorporated, which has its office in Louisville, is a national trade association with members in sixteen Central and Southern states. The principal product of the industry which it represents is hardwood dimension. This is a product defined as kiln-dried hardwoods processed to a point where the maximum waste is left at the dimension mill and the maximum utility is delivered to the user. The product is manufactured from rough boards to any prefabricated stage desired by the user. Hardwood dimension is used by countless industries, but the prefabricated wood parts are principally employed in furniture, automobile trucks and bodies, agricultural implements, sewing machines and radio cabinets, boats, toys, clocks, desks and all types of specialty millwork items.

This association promulgates industry standards and sponsors grading rules for four types of products: hardwood dimension, hardwood interior trim and molding, hardwood wall paneling, and hardwood stair treads. It

also promotes the industry products and serves as the bureau of information for users, members, Government agencies and the public at large. Its managing director and secretary is Phillips A. Hayward.

MAHOGANY ASSOCIATION, INCORPORATED

The Mahogany Association, Incorporated, was incorporated in 1922, although for several years before that and particularly the period of World War I, the mahogany industry co-operated to a certain extent.

For five or six years during the twenties, an active trade-extension campaign was carried on, but it then languished and the association was inactive until 1934 when interest was again revived. Between that time and the outbreak of World War II the use of mahogany increased threefold. Association activities in the order of relative importance have been:

(1) General publicity and trade promotion directed to furniture manufacturers, furniture dealers, designers, finish manufacturers, decorators, boat builders, casket manufacturers, and other woodworking plants. (2) Statistics covering inventories, production, shipments and orders received. (3) Railroad freight rates. (4) Official labels and tags for "Genuine Mahogany" furniture.

The principal publications of the association have been *How to Know Period Furniture, How to Identify Genuine Mahogany and Avoid Substitutes, The Mahogany Book* (1st, 2nd, 3rd and 4th editions).

The association has also put out two moving pictures, *The Romance of Mahogany* and *Masterpieces in Mahogany*, widely circulated, and two large traveling exhibits that have reached all parts of the country. Since the war their activities have been about ninety-percent war business and the remainder scattered. The war business is in connection with aircraft, PT boats and pattern lumber.

George N. Lamb is secretary of the Mahogany Association. Headquarters are maintained at 75 East Wacker Drive, Chicago, Ill.

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION

The first lumber trade association in the Northeastern states, consisting of New York, Pennsylvania and the New England states, came about at the time of the NRA Lumber Code Authority, that is, in 1933.

The Northeastern Lumber Manufacturers Association was chartered then for the purpose of "promoting the welfare and protecting the interests of the Northeastern lumber manufacturing industry." At that time there were some 3,000 members.

When the NRA was declared unconstitutional and the Lumber Code Authority consequently passed out of existence, a dozen or so farsighted manufacturers decided that a permanent trade organization should be maintained to follow out in general the original purposes of the Code

Authority group. During the succeeding years the association has grown from that small nucleus to its present size, which includes the principal manufacturers of both hardwood and softwood lumber in the area.

Membership is comprised of representative manufacturers of all sizes and now includes some of the largest, which in this section means producers of seven to ten million feet of lumber per year, and also some of the smallest, which means producers of a half-million per year and up.

The association sponsors grading rules for Northern white pine, Norway pine, Eastern spruce and balsam fir, which are the principal softwood species manufactured, and has constantly maintained the grading and inspection service covering them. Eastern hemlock is graded in accordance with the rules of the Northern Hemlock and Hardwood Manufacturers Association. The hardwoods, consisting principally of beech, birch, maple, ash, elm, oak and cherry, are graded in accordance with the rules of the National Hardwood Lumber Association, and consequently are subject to the inspection services of that agency.

The association has always taken an active interest in governmental regulations, freight rates and trade promotion.

Headquarters of the association are maintained at 271 Madison Avenue, New York, N. Y., and R. E. Broderick serves as executive secretary.

NORTHERN HEMLOCK AND HARDWOOD MANUFACTURERS ASSOCIATION

The Northern Hemlock and Hardwood Manufacturers Association was formed in April 1910 as an outgrowth of the Northwestern Hemlock Manufacturers Association, which was organized in 1894, and the Hardwood Lumber Manufacturers Association of Wisconsin. In 1910 headquarters of the association were established at Wausau, Wis., and continued at that point until early in 1915, when offices were moved to Oshkosh, Wis., the present address.

The aims and objectives have been to conduct advertising, market promotion and publicity work with a view to making known the qualities of Northern hardwoods and softwoods in detail to consumers, and informing the public on the problems of the lumber industry. The association conducts research work through the employment of experts or in co-operation with state or Federal departments, in order that efficiency in the handling of the forests, manufacture of forest products and utilization of these products may be improved. Its purpose is to establish and maintain uniform standard grades for lumber products, and to provide an inspection service available to members and nonmembers, and to uphold these standards. Through a transportation department established in 1915, studies are made of freight rates and transportation regulations, that the forest products of this region may move on fair rates under just regulations. Its statistical department compiles such data as are desirable that business may function most efficiently, and conducts such other

studies as may be of mutual service to the membership and to the public, relating to cutover land development, fire protection, insurance or reforestation.

This association was perhaps the first lumber organization to adopt a system whereby manufacturers endeavor to protect purchasers and consumers by showing on a certificate the detail of the inspection report covering the contents of the car.

The enactment of a forest-crop law in the state of Wisconsin was a definite attainment in forestry. It was accomplished through co-operation with the Wisconsin Conservation Department and private owners primarily for the purpose of improving and managing forest lands.

In the improvement of the end product and utilization, the association has co-operated in mill studies with the Forest Service and the United States Forest Products Laboratory in determining grade outturn and other factors. Considerable work has been done in connection with the proper piling of lumber to avoid crosser stain, which affects the grade. This has been carried on in co-operation with the Forest Products Laboratory and various methods of piling have been developed.

The membership is confined to Wisconsin and the Northern Peninsula of Michigan. The normal production within the area is approximately 800 million feet annually, divided into 60 percent hardwood and 40 percent softwood lumber. Species manufactured are birch, hard and soft maple, ash, rock and soft elm, basswood, beech, oak, white pine, Norway pine, and some other species not produced in great quantity.

As a part of the promotion and service department two field representatives are employed—trained men whose services are available without charge to specifiers and consumers. Their entire time is spent upon utilization problems, determining the most efficient selection and treatment of lumber for specific uses. O. T. Swan is secretary-manager of the association.

NORTHERN PINE MANUFACTURERS' ASSOCIATION

The Northern Pine Manufacturers' Association is the outgrowth of the old Mississippi Valley Lumbermen's Association which was formed in Minneapolis, Minn., in 1891. In 1906 the Mississippi Valley Lumbermen's Association was merged with the Wisconsin Valley Lumbermen's Association to form the Northern Pine Manufacturers' Association, and this organization has continued since that time, with the exception of two years of suspended animation during the depression years.

Its present activities consist chiefly of keeping the member mills informed of their obligations and rights under the regulations issued by the government agencies. In addition to this, they compile statistics on production, orders, shipments and stocks of lumber on hand, and maintain an inspection service. Their grading rules cover Northern white pine, Norway pine, Western white spruce and several allied species. The association has member mills in Ontario and Manitoba, as well as in Minnesota.

Headquarters are in Minneapolis, Minn. The secretary is W. A. Ellinger, who has served the association since 1911—probably the nation's oldest trade-association secretary in point of service.

SOUTHERN HARDWOOD PRODUCERS, INCORPORATED

The present Southern Hardwood Producers organization is the lineal descendant of a rather long line of associations of hardwood manufacturers dating back to the Mississippi Valley Hardwood Lumber Manufacturers Association. This early association was formed in 1898 to formulate and apply grading rules for hardwood lumber from the standpoint of the manufacturer. It was succeeded in 1902 by the Hardwood Manufacturers Association of the United States, which had the same primary purpose. It continued until late in 1919, when it was merged with the American Hardwood Manufacturers Association. This latter group had been formed in January 1919, by merging two species organizations: the American Oak Manufacturers Association and the Gum Lumber Manufacturers Association, which for several years had been successfully promoting the uses of the species they represented.

The American Hardwood Manufacturers Association had an elaborate program of activities for the benefit of its members, including trade promotion, inspection service and the gathering of statistics. Its statistical work, which involved the "open competition plan" of reporting sales transactions, was eventually attacked in the courts as being in restraint of trade; and in 1922 it dissolved as a result of the Supreme Court decision that the plan was illegal.

It was succeeded by the Hardwood Manufacturers Institute which undertook a program of activities in behalf of manufacturers south of the Ohio River. This organization abandoned the field of inspection to the National Hardwood Lumber Association, and concentrated on trade promotion and such statistical work as had been ruled legal and permissible by the courts. It was made the administrative agency for the hardwood lumber code under the NRA in 1933 and found little time for anything else. With the outlawing of the Code in 1935, the Institute was disbanded, and was followed by the present Southern Hardwood Producers, Incorporated.

This has been engaged in trade-promotion work, research and the conduct of a statistical information service, and has members throughout the Southern hardwood producing territory. Its staff of field men call regularly on the users of hardwood lumber and give technical advice and assistance on the efficient use of all the hardwood species growing in the lowland South. The association also publishes and distributes the Southern Hardwood Buyers Guide, descriptive literature regarding the properties of these species, and supplies small samples of the different kinds of wood to show their grain, texture and other characteristics.

The headquarters of the association are in Memphis, Tenn., and its secretary-manager is L. J. Heatherly.

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION

One of the smallest in number of members, but one of the strongest and most outstanding in record of accomplishment, is the Southern Cypress Manufacturers Association. The lifetime of the cypress industry has not been so long as some of the other species, since cypress was not commercially manufactured until near the close of the nineteenth century. The first attempt at organization was when a small group of operators in Louisiana formed the Teche and Gulf Coast Cypress and Shingle Association in 1890. It was succeeded three years later by the Southern Cypress Lumber and Shingle Association, which included manufacturers in both Louisiana and Arkansas and adopted the first official grading rules for cypress. In 1896 the cypress producers of the South Atlantic states organized the Atlantic Coast Cypress Association and adopted the rules of the Louisiana-Arkansas association. Later there was a Southern Cypress Lumber Association, which was active in only a desultory way. But it was not until 1905 that the present Southern Cypress Manufacturers Association was organized. It has functioned with notable success. Its grading rules have been generally recognized as the standard for red cypress and it has an efficient traffic department. Its outstanding achievement, however, has been in advertising and trade promotion. One of its first activities was that extensive national advertising campaign mentioned in the text. The slogans of the campaign, which is still sustained on a diminished basis, firmly established cypress in the public mind as a premier wood for external use where it is exposed to severe weather conditions.

James A. Prestridge is secretary-manager of the Southern Cypress Manufacturers Association with office at Jacksonville, Fla.

SOUTHERN PINE ASSOCIATION

The earliest manifestation of co-opeartive effort among the manufacturers of lumber in the South was the Missouri and Arkansas Lumber Association. It was organized in 1883 by sawmill operators in those two states, and it was succeeded by the Southern Lumber Manufacturers Association, formed in 1890. This was an ambitious organization which embraced manufacturers of pine, hardwood and cypress, and admitted wholesalers as honorary members. Apparently it found this diversity of interest too difficult to support, for in 1906 it changed its name to the Yellow Pine Manufacturers Association and devoted itself exclusively to the problems of pine producers.

It had its headquarters at St. Louis, and derived most of its support from the mills west of the Mississippi River and other pine mills of the South which sold their product through the St. Louis market. Meanwhile the pine manufacturers in Virginia and the Carolinas had been sporadi-

cally active in association work and had formed various local groups: The Carolina Dressed Lumber Association and the North Carolina Dressed Lumber Company in 1891, the Southern Dressed Lumber Association in 1895, and the Carolina Dressed Lumber Company in 1896. In 1897 association activities in this region were taken over by the North Carolina Pine Association, which later absorbed the South Carolina Lumber Association, and which continued to function successfully for thirty-five years.

Another strong local organization of Southern pine manufacturers was the Georgia-Florida Saw Mill Association which was formed in 1906 and carried on for twenty years. It was the outgrowth of the Georgia Sawmill Association, organized in 1899, which later changed its name to the Georgia Interstate Sawmill Association. Farther west was a group known as the Alabama-West Florida Sawmill Association, and there were short-lived local organizations of manufacturers in the South from time to time.

In 1915 the Southern Pine Association was formed and since then it has been the representative organization of the manufacturers of Southern pine lumber, having absorbed and succeeded the various local and regional groups. It is a corporation, chartered to collect and disseminate statistics and information of value to the manufacturers. It sells subscriptions to its statistical and other services, and the supporting mills are known as "subscribers" rather than members.

One of the original functions was the publication of official grading rules for pine and the maintenance of an inspection system. The rules were the outgrowth of the first rules for the grading of Southern pine lumber adopted by the Southern Lumber Manufacturers Association in 1890, and modified and modernized from time to time to meet changing conditions. In 1939 the Southern Pine Association divorced the grading rules and inspection service from its activities, and sponsored the organization of the Southern Pine Inspection Bureau, an autonomous body, which now carries on the work.

The Southern Pine Association conducts a well-rounded program of lumber-association work. It collects and publishes statistics as to lumber production, shipments, volume of sales and stocks on hand. (It does not report selling prices, or in any other way concern itself with prices.) It has a traffic department which protects the interest of its subscribers in freight-rate and transportation matters. It carries on a regular program of trade promotion and advertising publicizing the merits of Southern pine. It has an active conservation department, with a full-time professional forester, and has been a foremost factor in promoting forestry in the South, not only among its members and other industrial operators but also among small private owners of timberland.

The headquarters of the Southern Pine Association are maintained at Canal Building, New Orleans, La., and H. C. Berckes is secretary and manager.

WEST COAST LUMBERMEN'S ASSOCIATION

Co-operative effort among the lumber producers of the Pacific Northwest was originally centered around the problems of railroad rates and the establishment of uniform grades, sizes and patterns for their product. Sawmill operators in Washington got together and formed the Lumber Manufacturers Association in 1891, but it was short-lived. In 1901 the first step toward permanent regional organization was taken when the Pacific Coast Lumber Manufacturers Association was formed, composed principally of manufacturers of Douglas fir. In 1911 this association consolidated with the Southwestern Washington Lumber Manufacturers Association and the Oregon and Washington Lumber Manufacturers Association. The combined groups took the name of West Coast Lumber Manufacturers Association, which was continued until 1915 when it was reorganized as the West Coast Lumbermen's Association, its present style.

Extension of markets for the products of the industry it represents is the chief co-operative undertaking. In this work the main emphasis has been on the structural qualities of Douglas fir and the use of lumber in "engineered" construction. The technical department of the association has endeavored to keep pace with the progress in timber engineering, in strength data, the use of ring connectors, glued lamination and the whole field of modern design in the uses of wood for heavy construction.

One of the earliest activities had to do with establishing standardized grading rules. With the adoption of American Lumber Standards has come a constant expansion of grading specifications and inspection requirements as the West Coast mills have pushed their products into a widening range of uses and markets, both at home and overseas. After several years of consideration and hesitation, the association adopted the principle of grade-marking; and the maintenance and identification of lumber qualities have become one of the foremost policies of the association and its Bureau of Grades and Inspection.

The problems peculiar to the lumber industry in this region, especially those connected with the development of an enormous traffic through the Panama Canal, have occupied much of the organization's time. Much attention too was given to the export trade, Douglas fir having been the leading species in export for several years, and to tariff questions.

Forest conservation and timber cropping have taken a prominent place in the association's program, rooted in the Northwestern operators' fifty-year co-operative efforts in fire prevention and control. It made an aggressive effort to enforce the reforestation provisions of the NRA Lumber Code. Since then, in co-operation with the Pacific Northwest Loggers Association, it has maintained a strong forestry department. It has stood on its own Code of Forest Practice, designed both to protect and to restock the lands cut over; it has established a co-operative forest nurs-

ery; it has actively promoted the Tree Farm idea; and it looks forward to the time, in the near future, when five million acres of private forest land in the Douglas fir region will be identified with permanent forest production and permanent forest-using industries.

H. V. Simpson is secretary-manager of the West Coast Lumbermen's Association, and its headquarters are in Portland, Oregon.

WESTERN PINE ASSOCIATION

Trade association work in the Western pine region began in the nineties, with the formation of the Eastern Washington and Idaho Lumbermen's Association. The present Western Pine Association, however, traces its origin directly to the Western Pine Shippers' Association which was formed in 1903 and marked the beginning of broader co-operative effort. In 1906 its name was changed to Western Pine Manufacturers Association, and in 1931 it was consolidated with the California White and Sugar Pine Manufacturers Association which had been organized in 1916. The association resulting from the consolidation was styled the Western Pine Association, and its headquarters were continued in Portland, Oregon, where it has been located since 1917. The association has about 150 members, comprising some 80 percent of the regional cut of the Western pines or about 95 percent of the amount that goes into national distribution.

The avowed objectives of the Western Pine Association are: (1) to foster co-operative effort in the lumber manufacturing industry within the Western pine region, in order to further the interests of the members, and to that end to secure a full understanding of conditions surrounding the lumber market in their distributing territory; (2) to establish standard sizes and uniform grades as a basis of recognized values, and an adequate inspection service to maintain the integrity and uniformity of these grades; (3) to procure and furnish its members such statistical and other information as will apprise them fairly of the condition of the industry and of their markets; (4) to promote a greater and more widespread use of the products of its members, and to foster and protect the interests of consumers in such use; (5) to conduct a research program with the object of improving the manufacture, distribution and use of those products; (6) to secure just and reasonable transportation charges and to guard against discriminations by railroads and other carriers; (7) to promote conservation and sustained production of forest resources; and (8) generally to adopt or sponsor from time to time such measures as may be deemed necessary to protect the industry.

The Western Pine Association has been conspicuous among lumber trade associations for the scope and effectiveness of its work, particularly in forestry and research. It has a strong forest engineering department, with a staff of trained district men who spend their time promoting the advanced forest-practice rules which it sponsors. It has gone further than

any other of the regional associations in research, maintaining a forest-products laboratory at Portland which already has an enviable record of accomplishment and gives promise of even greater things.

S. V. Fullaway, Jr., is secretary-manager of the Western Pine Association, assisted by a staff of fifty.

THE CONCATENATED ORDER OF HOO-HOO

What is probably a unique organization in the industrial and fraternal world is the Concatenated Order of Hoo-Hoo—a society whose membership is entirely within one industry, the lumber business.

It had its origin in 1892, when some lumbermen and lumber trade-paper men on the way home from a convention, were held up by a railroad wreck at Gurdon, Arkansas, and sought some means of spending their idle time. The ringleader was Bolling Arthur Johnson, a trade-press representative, who was an admirer of Lewis Carroll's works, so the supreme officer of the order was called "The Snark of the Universe." Other officers were also given fanciful names, such as Bojum, Arcanoper, Custocation, etc. The official insignia is a black cat with its tail curled up in the shape of a figure 9, and cats and 9's figure prominently in the order's affairs. A Hoo-Hoo meeting is officially styled a con*cat*enation, and the annual meeting is held at 9:00 A.M. on the ninth day of September, the ninth month in the year.

The purposes were originally social and more or less frivolous, but are more serious now. The order still promotes friendship and confidence among lumbermen, but concerns itself also with the study of wood and its uses, conservation and forestry, wood-trade promotion and the maintenance of ethics in the industry. The membership is limited to active lumbermen, lumber trade-association officials and representatives of the trade press.

B. F. Springer, with office at Milwaukee, Wis., is secretary.

III

FOREST POLICY STATEMENT

of the

NATIONAL LUMBER MANUFACTURERS ASSOCIATION

November 16, 1950

Permanent lumber and other forest-using industries are essential to the national welfare. We recognize the vital relation of forest conservation to the permanency of such industries. We believe that in forest ownership, operation and renewal, the fullest possible reliance upon private enterprise and initiative should be continued. At the same time the industry recognizes an obligation to maintain its forest lands in productive condition. In order to accomplish this objective, the full resources of the industry should be made available to further desirable woods practices on industry-owned lands as well as on other forest lands in private ownership.

The fundamental necessity for continuing and expanding utilization of and markets for forest products by private industry in the development of permanent forest industries and improved forest management must be recognized.

Timber is a crop. When protected from fire, insects and disease, and managed for continuous production, a forest area is a Tree Farm. We believe that the industry program of encouraging Tree Farms is one means of assuring intensive protection from fire and the application of improved forest management practices on individual properties. This voluntary undertaking of private land owners, designed to assure continuous forest growth, has brought about a substantial improvement of forest practices and should be continuously expanded.

We are opposed to Federal regulation of private forest management practices and Federal control of State forest policies. If the people of any State determine that public regulation is necessary or desirable, such regulation should be applied and administered under State law and the need or desirability of such regulation and its scope if undertaken should be determined in each State by the people of the State, without Federal interference or intervention.

Protection against fire is a major need to assure continuous production of forest crops. We support the co-operative principle of protection against fire as developed under the Clarke-McNary Act of 1924. This Act has operated successfully for many years under joint effort of state, federal and private agencies. This co-operative program should be continued but its operation should be regularly analyzed and reviewed jointly by state

and federal officials and industry representatives to assure its effectiveness and economical administration.

Protection against insects and diseases under the Forest Pest Control Act of 1948 and the earlier Lee Act should be administered under a similar national plan which recognizes the joint responsibility of federal, state and private agencies. The private owners everywhere should co-operate in setting up an effective detection service. We commend the fine progress in technical control methods and urge further effort in this field. Situations are continuously arising which show that the danger of heavy losses from insects and disease has not been sufficiently appraised by either forest owners or foresters. Therefore, the organization of national, regional and state action committees of private, state and federal groups is necessary to determine values at stake and all control needs and to give necessary leadership in protecting the timber crops threatened. Such joint groups should regularly analyze and review the effectiveness of insect and disease control efforts and make recommendations to a central authority to assure effective handling of the program on a national scale at lowest cost.

The co-operative and educational approach to forest problems should be vigorously continued on the basis of three-way collaboration by private forest owners, and state and federal governments.

To retain the maximum possible proportion of forest land in private tax-paying ownership is a sound national land policy. Only those lands which private ownership cannot keep productive should be taken into public ownership, primarily by the States, and secondarily by the Federal Government. We further believe it to be a sound national land policy to exchange public lands for private lands, in order to consolidate both public holdings and private holdings so as to improve forest management. We favor the transfer of public forest lands to private ownership and of federal land to state ownership where the public interest will be served; and the continuous review of the situation as to public ownership in each state by an agency representing federal, state and private interest.

We invite all organizations and individuals to join in furthering the continuous production of forest crops through the acceptance and registration of commercial "Tree Farms" and through "Keep America Green" and "More Trees for America" programs.

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THIS FASCINATING LUMBER BUSINESS

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(*Continued on back flap*)

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(*Continued from front flap*)

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